TM 9-6101

DEPARTMENT OF THE ARMY TECHNICAL MANUAL

ORDNANCE MAINTENANCE

TELESCOPE MOUNTS M23, M28, M31, M32 M42, M46, M52C, M52D M54, AND M71

DEPARTMENT OF THE ARMY • FEBRUARY 1954

This manual is correct to 25 November 1953

*TM 9-6101

TECHNICAL MANUAL
No. 9-6101

DEPARTMENT OF THE ARMY
WASHINGTON 25, D. C., *26 February 1954*

ORDNANCE MAINTENANCE: TELESCOPE MOUNTS M23, M28, M31, M32, M42, M46, M52C, M52D, M54 AND M71

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*This manual supersedes that portion of TM 9-1545, 12 January 1945, that covers telescope mounts M23, M28, M42, M46, and M54.

CHAPTER 1

INTRODUCTION

Section I. GENERAL

1. Scope

a. This manual is published for the use of personnel responsible for field and depot maintenance of telescope mounts M23, M28, M31, M32, M42, M46, M52C, M52D, M54, and M71. This manual does not contain information that is intended primarily for the using organization, since such information is available to ordnance maintenance personnel in the pertinent operator's technical manuals or field manuals.

b. This manual contains a description of and procedures for inspection, disassembly, repair and rebuild, and assembly of the telescope mounts M23, M28, M31, M32, M42, M46, M52C, M52D, M54, and M71.

c. A list of references, including supply and technical manuals, and other available publications applicable to the materiel is contained in the appendix.

d. Operation, lubrication, and all maintenance operations allocated to using organizations in performing maintenance work within their scope for the telescope mounts are contained in the pertinent operator's technical manuals.

e. This manual differs from TM 9–1545, dated 12 January 1945, as outlined in (1) through (3) below.

(1) Adds information on: Telescope mounts M31, M32, M52C, M52D, and M71.

(2) Revises information on: Telescope mounts M23, M28, M42, M46, and M54.

(3) Deletes reference to telescope mounts M3, M7, M15A1, M16, M19, M21, M22, M24, M26, M29, M36, M39, M40, M41, M41A1, and M50; range quadrants M1, M3, M5, M8, M10C, and M10D; and instrument lights M5, M6, M7, M13, M16, M18, M20, M22, M24, M30, M31, M33, M34, and M35.

(4) Telescope mounts M3A1, M16A1, M18A1, M21A1, M25, M30, M41A2, M43, M44, M44A1, M69, M75, and M76 will be covered in TM 9–6103.

(5) Telescope mounts M24A1, M55, M56, M57, M63, M64, M65, M70, M72, M77, and M82 will be covered in TM 9–6099.

(6) Telescope mounts M59, M78, and M79 will be covered in TM 9–6107.

2. Field and Depot Maintenance Allocation

The publication of instructions for complete disassembly and rebuild is not to be construed as authority for the performance by field maintenance units of those functions that are restricted to depots and arsenals. In general, the prescribed maintenance responsibilities will apply as reflected in the allocation of maintenance parts and tools listed in the appropriate columns of Department of the Army Supply Manual ORD 8 SNL F–224 for telescope mounts M28, M46, M52C, M52D, and M54; ORD 8 SNL F–197, Section 2, for telescope mount M23; ORD 8 SNL F–375 for telescope mounts M31 and M32; ORD 8 SNL F–256 for telescope mount M42; ORD 8 SNL F–376 for telescope mount M71; and ORD 6 SNL J–10, Sections 13 and 14. Instructions for depot maintenance are to be used by maintenance companies in the field only when the tactical situation makes the repair functions imperative. Provisions of parts listed in the depot stock guide column of ORD 8 SNL F–197, F–224, F–226, F–375, and F–376 will be made to field maintenance only when the emergency nature of the maintenance to be performed has been certified by a responsible officer of the requisitioning organization.

3. Forms, Records, and Reports

a. General. Responsibility for the proper execution of forms, records, and reports rests upon the officers of all units maintaining this equipment. However, the value of accurate records must be fully appreciated by all persons responsible for their compilation, maintenance, and use. Records, reports, and authorized forms are normally utilized to indicate the type, quantity, and condition of materiel to be inspected, to be repaired, or to be used in repair. Properly executed forms convey authorization and serve as records for repair or replacement of materiel in the hands of troops and for delivery of materiel requiring further repair to ordnance shops in arsenals, depots, etc. The forms, records, and reports establish the work required, the progress of the work within the shops, and the status of the materiel upon completion of its repair.

b. Authorized Forms. The forms generally applicable to units maintaining this materiel are listed in the appendix. For a current and complete listing of all forms, see SR 310–20–6. For instructions on the use of these forms, see FM 9–10. Additional forms applicable to the using personnel are listed in the operator's manual.

c. Field Reports of Accidents. The reports necessary to comply with the requirements of the Army safety program are prescribed in detail in SR 385–10–40. These reports are required whenever accidents involving injury to personnel or damage to materiel occur.

d. Report of Unsatisfactory Equipment or Materials. Any suggestions for improvement in design and maintenance of equipment and spare parts, safety and efficiency of operation, or pertaining to the application of prescribed lubricants, and/or preserving materials, or technical inaccuracies noted in Department of the Army publications will be reported through technical channels, as prescribed in SR 700–45–5, to the Chief of Ordnance, Department of the Army, Washington 25, D. C., ATTN: ORDFM, using DA Form 468, Unsatisfactory Equipment Report. Such suggestions are encouraged so that other organizations may benefit.

Note. Do not report all failures that occur. Report only REPEATED OR RECURRENT failures that indicate unsatisfactory design or material. See also SR 700–45–5 and the printed instructions on DA Form 468.

Section II. DESCRIPTION AND DATA

4. Description

The basic purpose of the telescope mounts covered herein is to provide for the mounting and positioning of elbow-type telescopes (fig. 1) on motor carriages, field artillery, and antiaircraft artillery (fig. 2). The telescope mounts covered in this manual are of the rigidly mounted, single purpose type (except for the M32). They are so called because they are mounted directly to the gun, quadrant and/or carriage for a precise purpose; that is, movement in either azimuth or elevation. The telescope mount M32 moves in azimuth and elevation. These telescope mounts have elevation and azimuth adjusting worm mechanisms (fig. 3) for alining the telescope to the axis of the bore of the gun during boresighting. The adjustments are made by loosening a clamping screw. The worm can then be turned by means of a screwdriver and will adjust the mount in azimuth and/or elevation by moving the spindle and/or telescope holder (fig. 3).

5. Functional Description

a. General. The telescope mounts covered herein function in the same manner except as noted in *b* through *j* below. Each mount consists principally of a mounting bracket, spindle assembly, elevation worm housing, and telescope holder (fig. 3). The mounts are adjusted to the line of sight of the axis of the bore of the gun by means of worm adjusting mechanisms. These worms have clamping screws, to keep the mount from being accidentally jarred out of boresight adjustment. With the elbow telescope mounted in the telescope mount and boresighted to the axis of the gun, motion of the telescope and mount is derived from the movement of the piece in azimuth or elevation. That is, when a telescope mount on the azimuth side is secured in place, the movement of the piece in azimuth will move the telescope and mount in azimuth. The telescope mount on

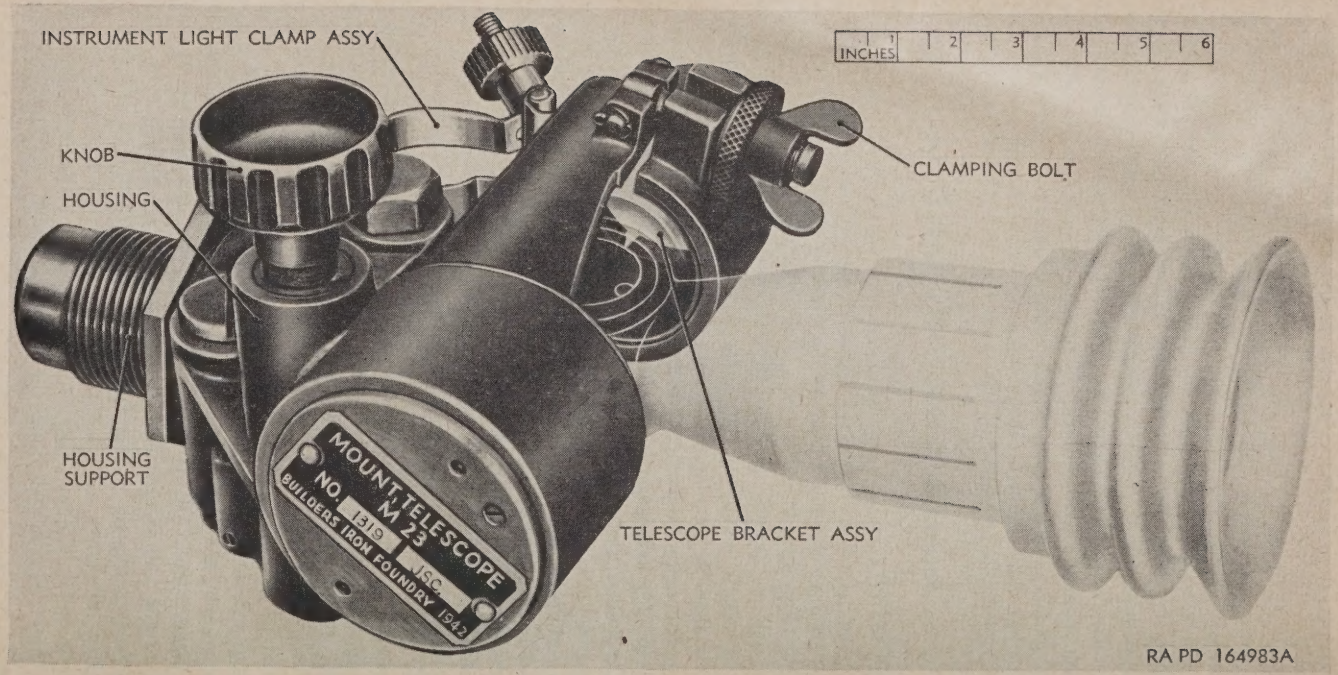

Figure 1. Telescope mount M23.

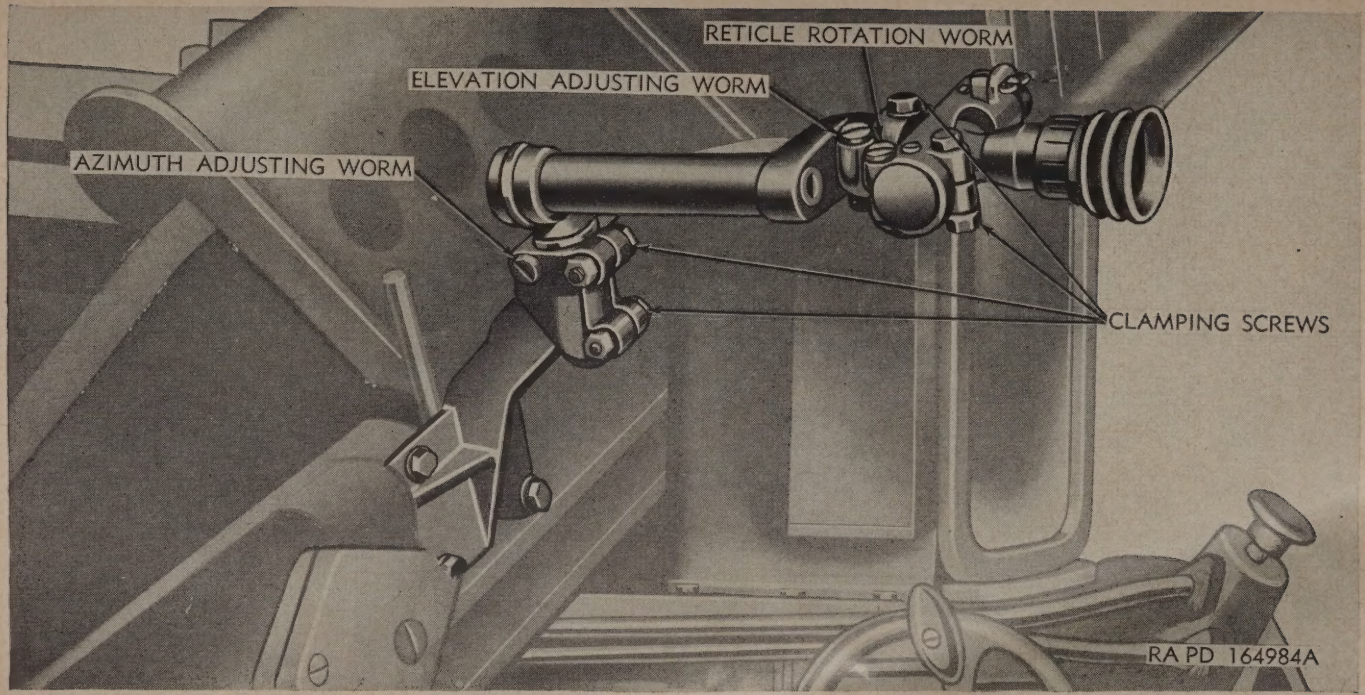

Figure 2. Telescope mount M54 on carriage with telescope mounted.

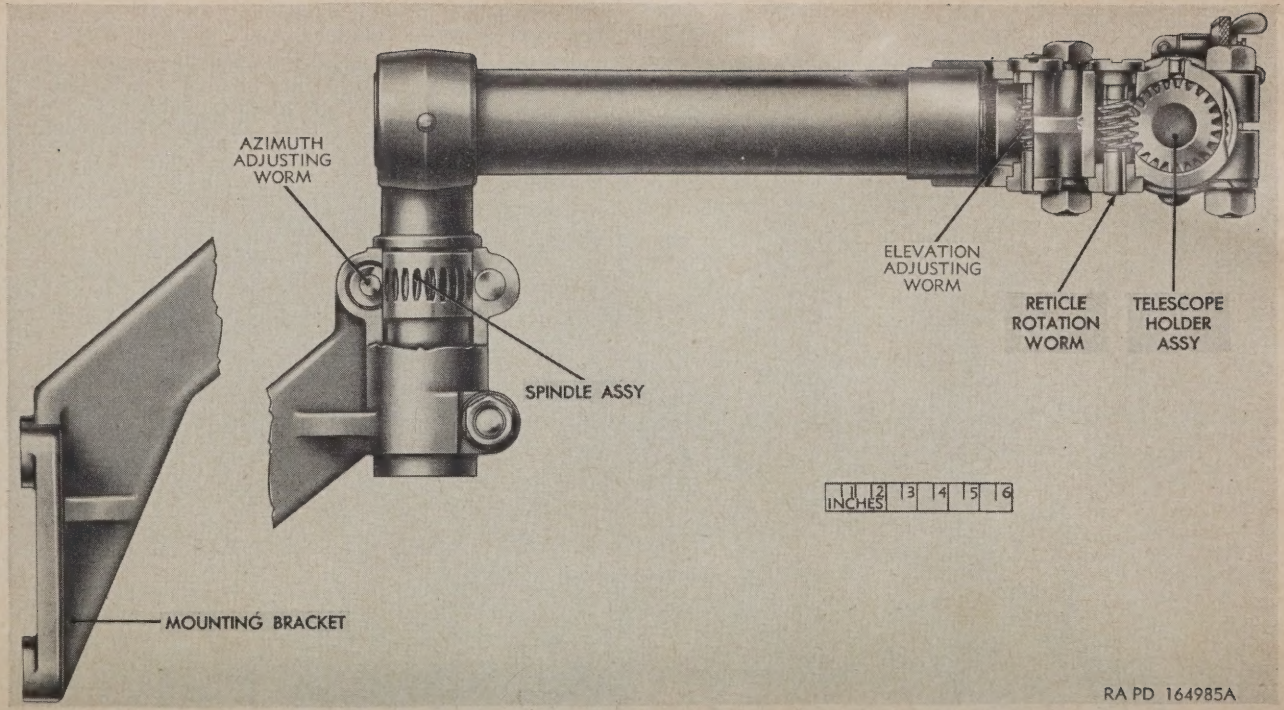

Figure 3. Telescope mount M54—sectional view of azimuth and elevation adjusting mechanism.

the elevation side will operate in the same manner. Telescope mount M32 (fig. 4) has a gear mechanism that engages with the gears of the gun elevation control mechanism, thereby deriving its elevation motion directly from the elevation gear train mechanism of the gun. Azimuth motion of the mount M32, which is rigidly mounted, is derived from the movement of the piece in azimuth.

b. Housing Support (*Telescope Mount M23 Only*). The housing support (fig. 1) performs two functions. It is the means by which the mount is attached to the weapon and is also the elevation worm gear by which the mount is adjusted in elevation.

c. Housing (*Telescope Mount M23 Only*). The housing (fig. 1) contains the elevation adjusting worm. It also forms the mount for the telescope bracket assembly. A clamping bolt passes through the split part of the housing and is used for clamping the housing around the support. The elevation adjusting worm engages with the gear teeth on the support. Since the support is rigidly mounted to the range quadrant M4 or M4A1, rotation of the worm causes the housing to rotate in a vertical or nearly vertical plane parallel to the bore of the gun. The worm is used when adjusting the telescope in elevation with respect to the bore of the gun.

d. Telescope Bracket Assembly (*Telescope Mount M23 Only*). The telescope bracket assembly (fig. 1) holds the telescope. One end of the telescope bracket fits into the housing and is provided with worm gear teeth that are engaged by the bracket adjusting worm, which is mounted in the housing (fig. 1). The other end of the bracket is provided with a clamp that fits around the telescope body. Rotation of the adjusting worm, which is actuated by a knob (fig. 1), causes the telescope to rotate about its optical axis, thereby providing alinement for the telescope reticle.

e. Mounting Bracket (*Telescope Mount M54*) (fig. 3). The mounting bracket bolts onto the gun carriage and is the supporting element of the mount. Two split clamping collars lock the azimuth adjustment settings to prevent accidental rotation and/or backlash of the adjusting worm.

f. Spindle Assembly (fig. 3). The spindle assembly fits into the mounting bracket. It houses the azimuth worm gear by which the mount is adjusted in azimuth. The other end of the spindle assembly supports the holder assembly.

g. Telescope Holder Assembly (fig. 3). The telescope holder assembly is that part of the instrument that holds the telescope. One end of the assembly fits into the elevation housing. A clamping device, which is a part of the holder, secures the telescope.

h. Azimuth Mechanism (*Telescope Mounts M52C and M52D Only*). Deflection angles are set on an azimuth gear segment. A housing assembly, which includes a spindle for attaching the elbow telescope, is

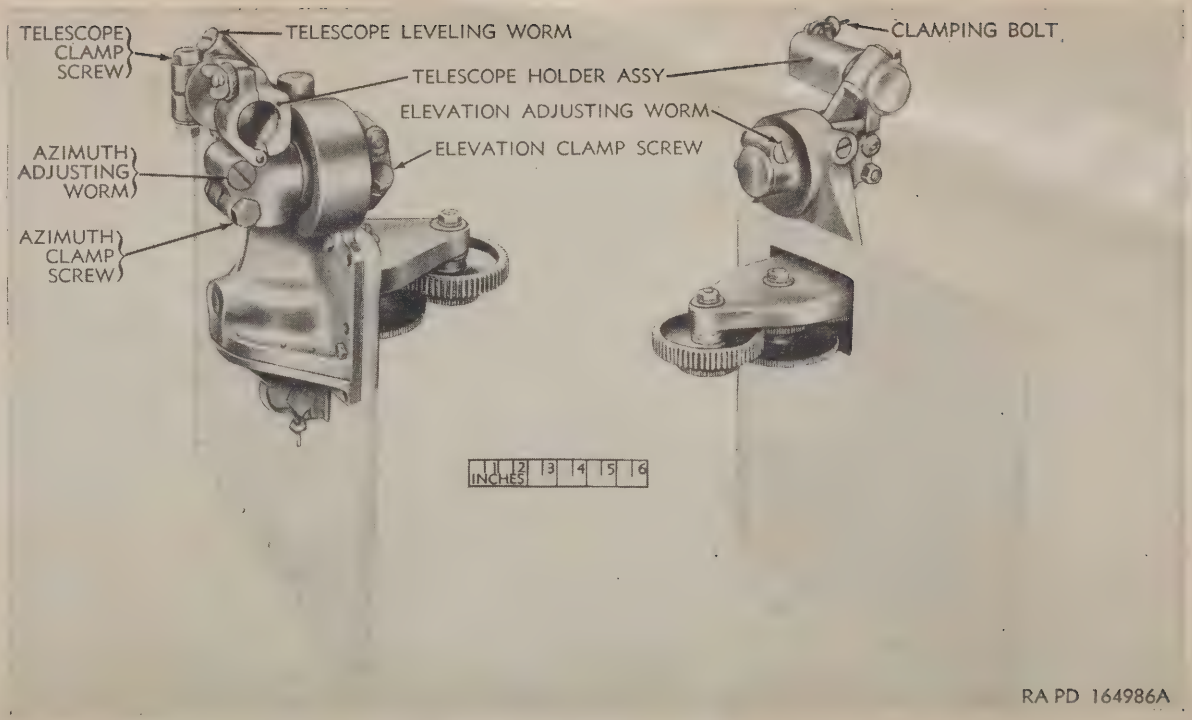

Figure 4. Telescope mount M32.

secured to the azimuth gear segment, so that any rotation of the knob is transmitted directly to the line of sight.

i. Elevating Mechanism (Telescope Mounts M52C and M52D Only). The elevating mechanism is mounted in the housing assembly. When the elevation knob is turned, motion is transmitted through a worm and gear segment to the spindle, to elevate or depress the line of sight.

j. Illumination (Telescope Mounts M52C and M52D) (fig. 5). A built-in lighting system illuminates the azimuth scale and micrometer and the reticle of the elbow telescope. A lamp bracket houses a socket assembly having a double contact bayonet-type socket. A 6- to 8-volt electric lamp is mounted in one end of the socket and the power cable plugs into the other end. The cover assembly includes a toggle switch and three double contact bayonet-type sockets (fig. 5). One socket serves the telescope mount, another serves the elbow telescope, and a third is for plugging in the outside power source.

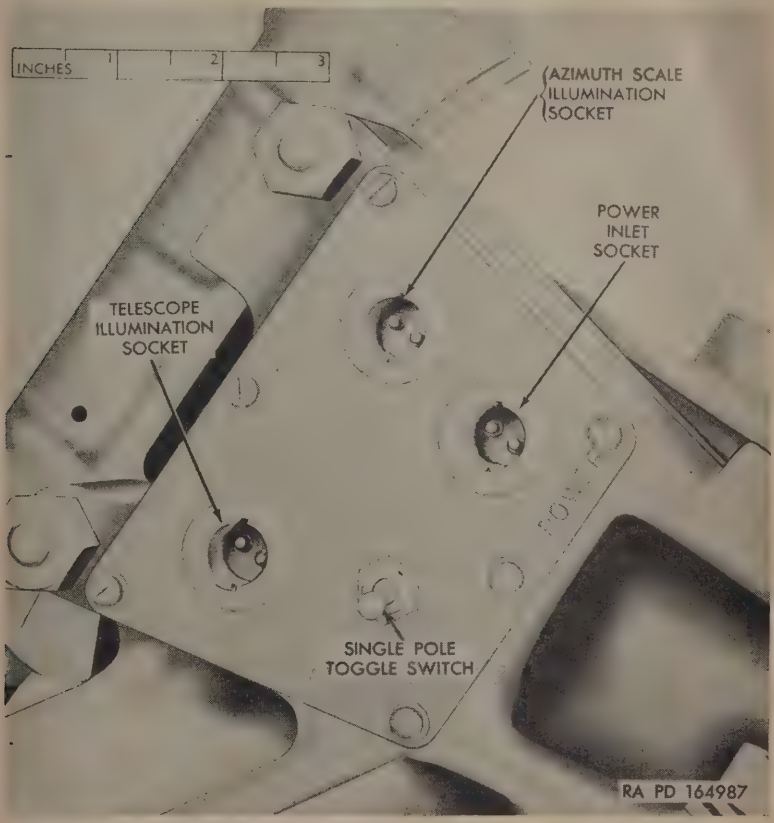

Figure 5. Lighting system sockets—Telescope mounts M52C and M52D.

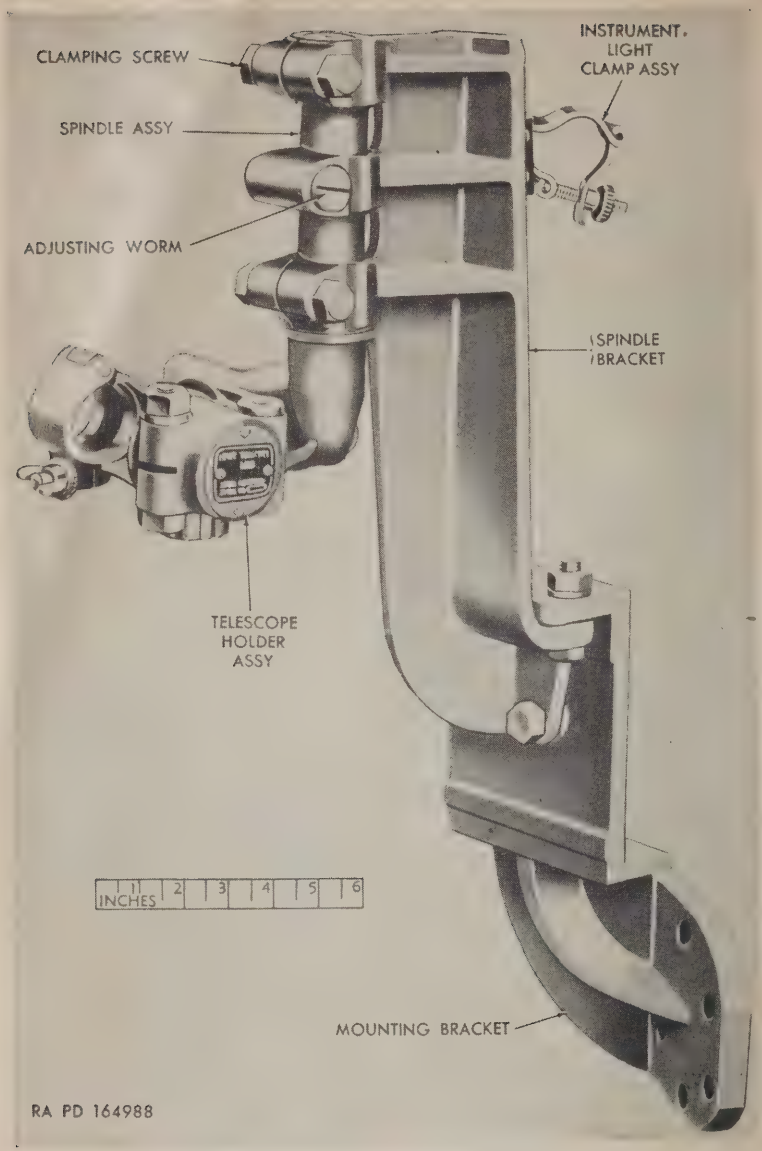

Figure 6. Telescope mount M28.

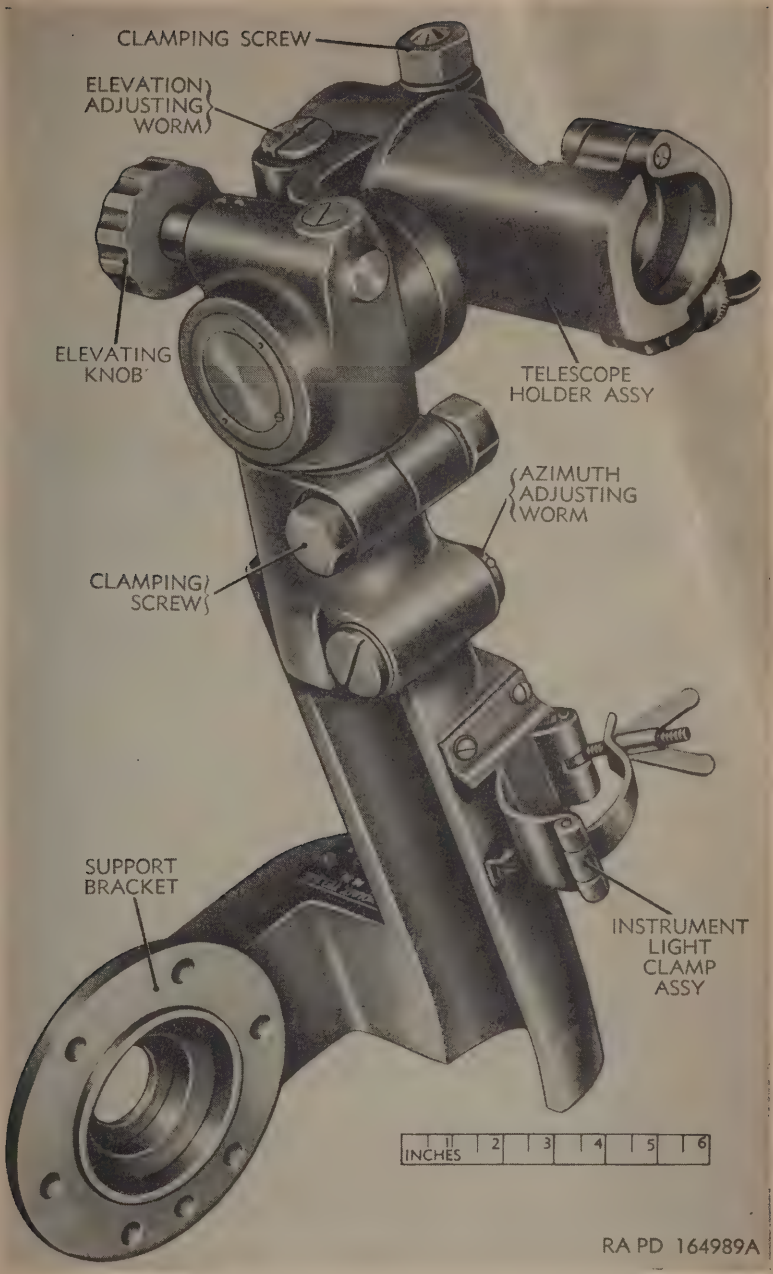

Figure 7. Telescope mount M31—assembled view.

6. Differences Between Models

a. General. The mounting brackets of these mounts are shaped to fit their particular mounting surfaces on the weapon. The spindles in the different mounts are of varying lengths.

b. Telescope Mounts M23, M28, M31, M46, M54, and M71. These mounts are different in the design of their mounting brackets and the length of their spindles.

(1) The telescope mount M23 is mounted by means of a threaded support (fig. 1).

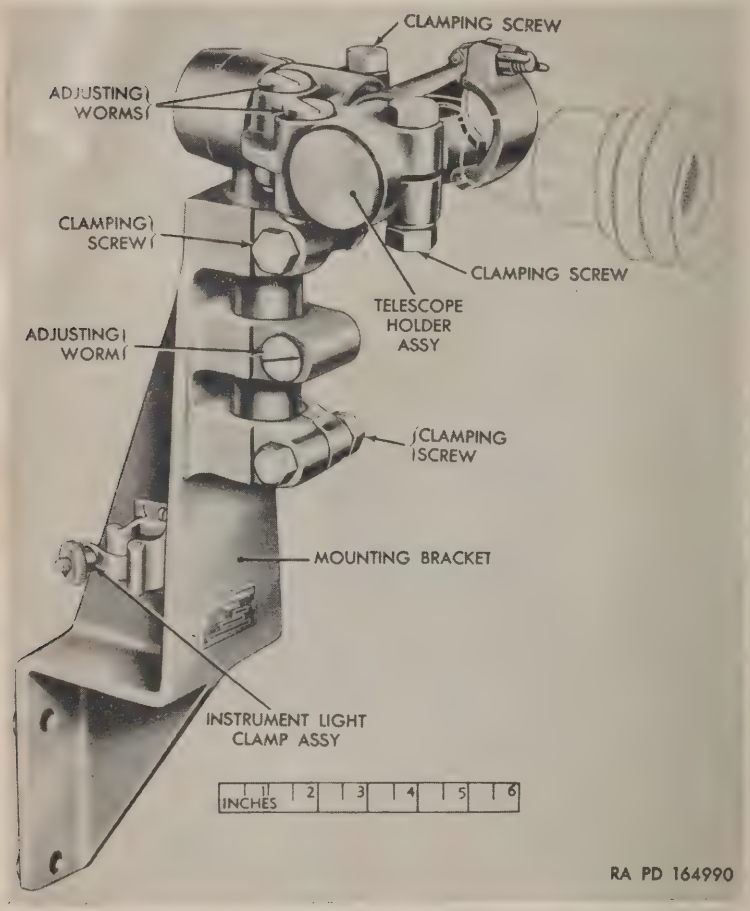

Figure 8. Telescope mount M46—assembled view.

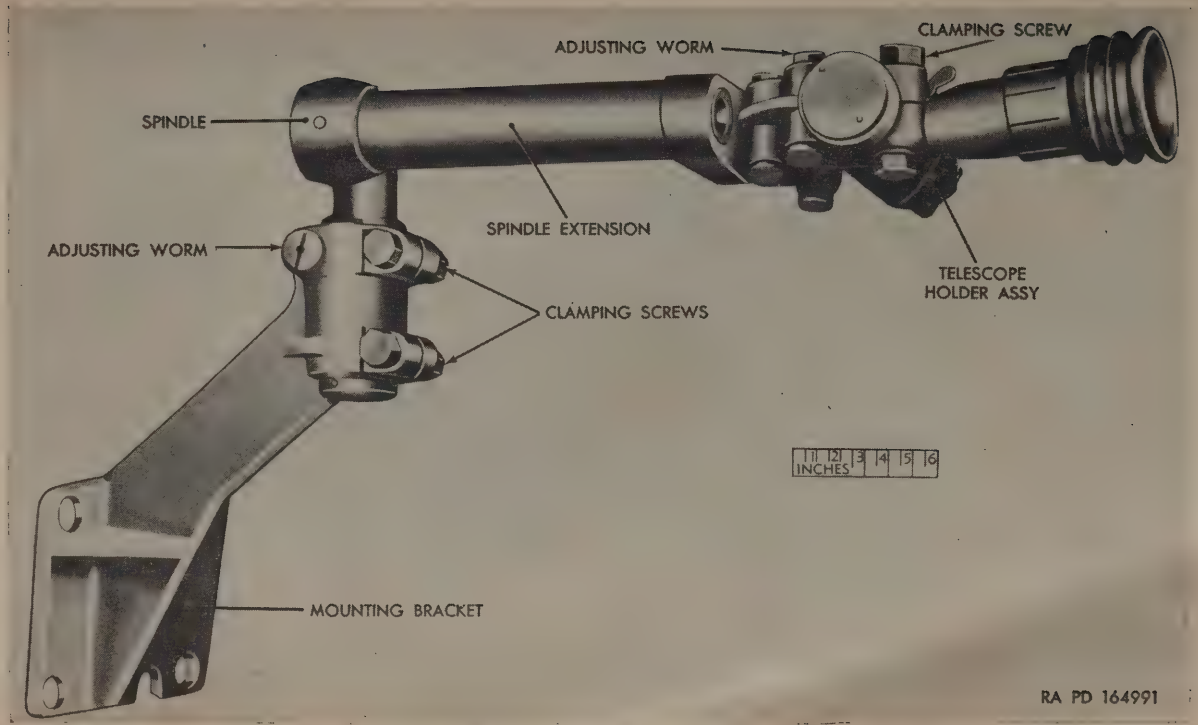

Figure 9. Telescope mount M54—assembled view.

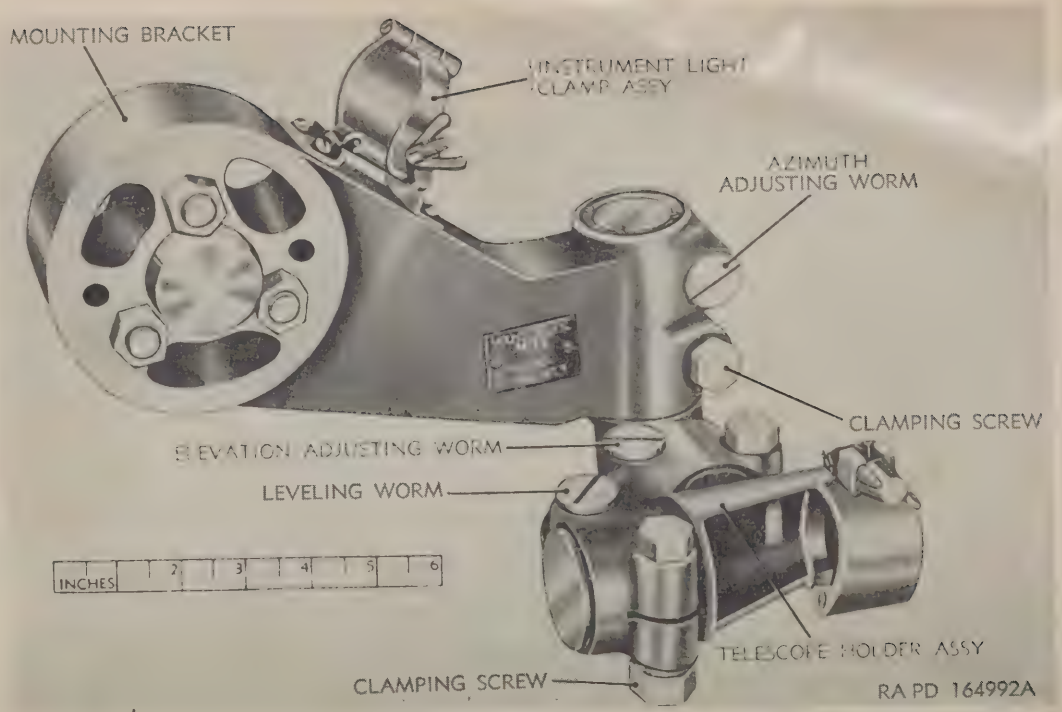

Figure 10. Telescope mount M71—assembled view.

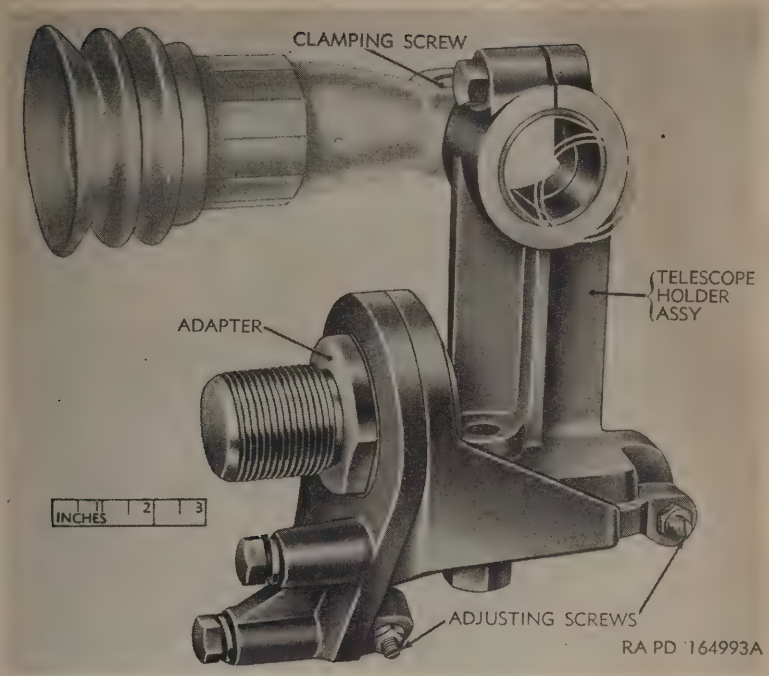

Figure 11. Telescope mount M42.

(2) The telescope mount M28 (fig. 6) is similar to the M23, except that, the M28 has a mounting bracket of its own, by which it is mounted in the on-carriage position.

(3) The telescope mounts M31 (fig. 7), M46 (fig. 8), M54 (fig. 9), and M71 (fig. 10) are similar to the M28, except for the length and position of the spindle.

(4) The telescope mount M32 (fig. 4) supports the elbow telescope in the same manner as the M23 and is similar, except that telescope mount M32 has a gear train that, when installed, engages with a gear train of the gun elevation control mechanism.

(5) The telescope mount M42 (fig. 11) is mounted on the range quadrant in the same manner as the M23; i. e., by means of a threaded adapter (fig. 11). The holders of the M42 (fig. 11) and M23 (fig. 1) differ in detailed design.

(6) The telescope mounts M52C and M52D (figs. 12 and 13) are of the same basic design. They differ from the other mounts in this manual in that they have an azimuth mechanism, elevating mechanism, and a built-in lighting system.

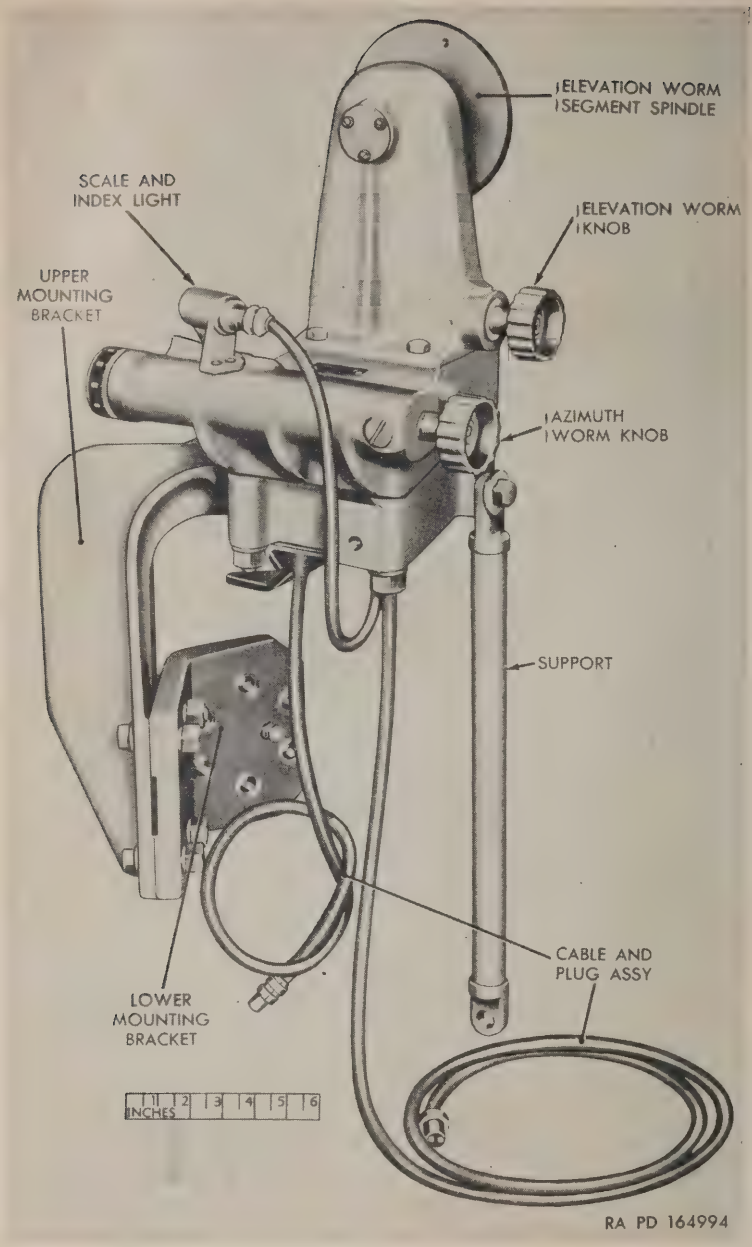

Figure 12. Telescope mount M52C—assembled view.

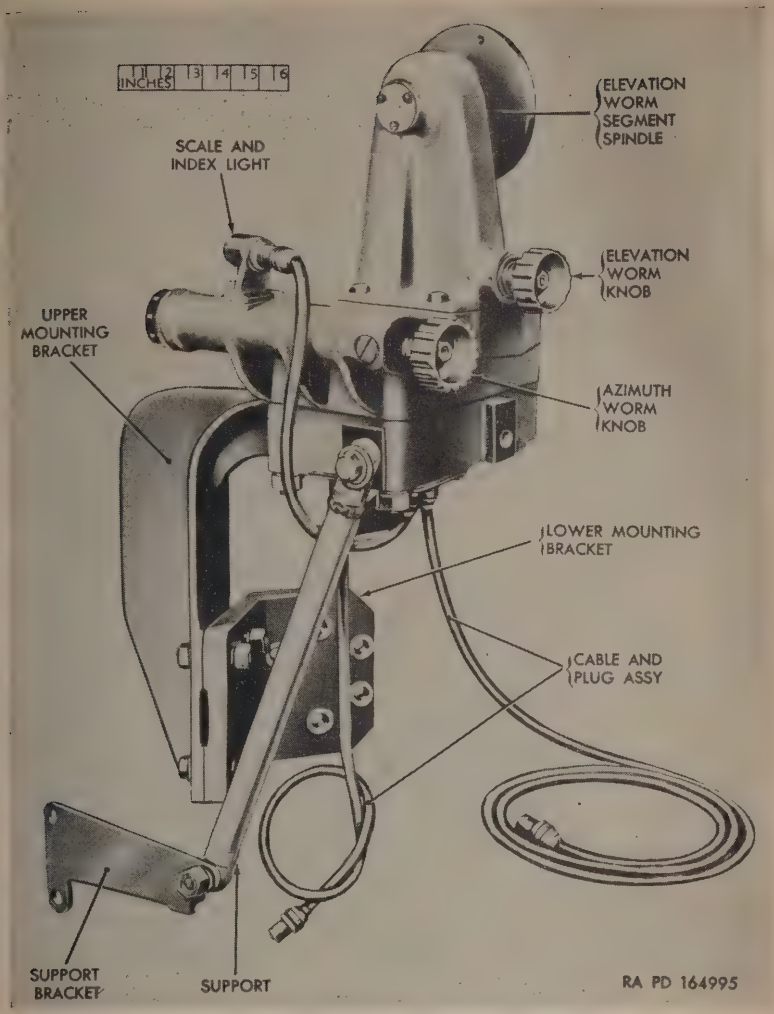

Figure 13. Telescope mount M52D—assembled view.

7. Tabulated Data

The tabulated data listed in tables I and II covers the telescope mounts in this manual.

Table I. Weights and Measurements

Telescope mount	No. per box	Length (in.)	Width (in.)	Height (in.)	Gross weight (lb)
M23 W/E	1	8½	8½	4½	14
M28 W/E	1	17½	11¾	12	68
M31 W/E	1	16	8½	15⅛	25
M32 W/E	1	17	15½	12	60
M42 W/E	1	8	8	4	29
M46 W/E	1	17⅛	11¾	12	68
M52C W/E	1	30	16	17	225
M52D W/E	1	30	16	17	225
M54 W/E	1	15	8¾	7	45
M71 W/E	1	15	8¾	7	34

Table II. Application of Telescope Mounts

Telescope mount	Type telescope	Weapons and model	Carriage or mount
M23	Elbow M16A1C or M16A1D.	105-mm howitzer M2A1.	105-mm howitzer carriage M2A1 and M2A2.
M28	Elbow M24A1	90-mm gun M1 or M2.	90-mm AA gun mounts M1A1 and M2.
M31	Elbow M24A1	120-mm gun M1	120-mm AA gun mount M1A1.
M32	Elbow M16A1N	120-mm gun M1	120-mm AA gun mount M1A1.
M42	Elbow M16A1C	105-mm howitzer M2A1.	105-mm howitzer motor carriage M7 and M7B1.
M46	Elbow M26	90-mm gun M1	90-mm AA gun mount M3.
M52C	Elbow M6A1	90-mm gun M1	90-mm AA gun mount M3.
M52D	Elbow M6A1	90-mm gun M1 or M1A1.	90-mm AA gun mount M1A1.
M54	Elbow M26A1	90-mm gun M1 or M1A1.	90-mm AA gun mount M1 and M1A1.
M71	Elbow M16A1F M16A1G.	155-mm gun M2	155-mm gun motor carriage M40.
		8-in howitzer M2	155-mm gun carriage M1. 8-in howitzer carriage M1.

CHAPTER 2

PARTS, SPECIAL TOOLS, AND EQUIPMENT FOR FIELD AND DEPOT MAINTENANCE

8. General

Tools and equipment and maintenance parts over and above those available to the using organization are supplied to ordnance field maintenance units and depot shops for maintaining, repairing, and for rebuilding the materiel.

9. Parts

Maintenance parts are listed in Department of the Army Supply Manuals ORD 8 SNL F–224 for telescope mounts M28, M46, M52C, M52D, and M54; ORD 8 SNL F–197, Section 2 for telescope mount M23; ORD 8 SNL F–375 for telescope mounts M31 and M32; ORD 8 SNL F–256 for telescope mount M42; and ORD 8 SNL F–376 for telescope mount M71; which are the authority for requisitioning replacements. Parts not listed in an ORD 8 manual, but required by depot shops in rebuild operations, may be requisitioned from the listing in the corresponding ORD 9 manual and will be supplied if available, when the need is substantiated. Requisitions for ORD 9 parts will contain a complete justification of requirements.

10. Common Tools and Equipment

Standard and commonly used tools and equipment having general application are authorized for issue by T/A and T/O & E. They are not specifically identified in this manual.

11. Special Tools and Equipment

The design of these telescope mounts is such that no special tools or equipment are necessary to perform the operations described in this manual.

CHAPTER 3

INSPECTION

Section I. GENERAL

12. Scope

This chapter provides specific instructions for the technical inspections by ordnance maintenance personnel of telescope mounts M23, M28, M31, M32, M42, M46, M52C, M52D, M54, and M71 either in the hands of troops or when received for repair in ordnance shops. It also defines the in-process inspection of materiel during repair and rebuild and the final inspection after repair and rebuild has been completed.

13. Purposes of Inspection

Inspection is primarily for the purpose of—

a. Determining the condition of an item; i. e., serviceable or unserviceable.

b. Recognizing conditions that would cause failure.

c. Assuring proper application of maintenance policies at prescribed levels.

d. Determining the ability of a unit to accomplish its maintenance and supply missions.

14. Categories of Technical Inspections

In general, there are five categories of inspection performed by ordnance maintenance personnel.

a. Overall Inspection. This is an overall inspection performed periodically on *all* materiel in the hands of troops. It is also performed on materiel received for repair in field or depot maintenance shops. Upon completion of an inspection for serviceability, materiel will be declared either serviceable or unserviceable. This inspection may be limited in scope, such as an inspection of materiel in the hands of troops, or detailed in scope, such as an ordnance shop inspection. Detailed procedures are presented in paragraphs 16 through 22.

b. Preembarkation Inspection. This inspection is performed on materiel in the hands of troops alerted for oversea duty to insure that such materiel will not become unserviceable or worn out in a rela-

tively short time. It prescribes a higher percentage of remaining usable life in serviceable materiel to meet a specific need beyond minimum serviceability.

c. In-Process Inspection. This inspection is performed by the repair technician and/or floor inspector in the process of repairing or rebuilding the materiel and its components. It insures that all parts conform to prescribed standards, that the workmanship is in accordance with approved methods and procedures, and that deficiencies not disclosed by the technicial inspection are found and corrected. Detailed instructions are contained in chapter 4.

d. Final Inspection. This is an acceptance inspection performed by a final inspector, after repair or rebuild has been completed, to insure that the materiel is acceptable according to established standards. Detailed instructions are contained in chapter 5.

e. Spot-Check Inspection. This is a periodic overall inspection performed on only a percentage of the materiel in each unit to determine the adequacy and effectiveness of organizational and field maintenance.

15. Classification of Materiel

All ordnance materiel after inspection is classified as described in *a* and *b* below.

a. Serviceable. Serviceable property consists of all new or used supplies that are in condition for issue for the purpose intended and all supplies that can be placed in such condition through pre-issue tests or inspections, in-storage deprocessing, installation of accessories, correction of minor deficiencies that have developed since the item was last classified as serviceable, application of modification work orders for which parts are available, or assembly of available components.

b. Unserviceable. Unserviceable property consists of all supplies that are not serviceable (*a* above). The definition of unserviceable property is further broken down into the following subclassifications: property that is unserviceable but economically reparable and property that is unserviceable and not economically reparable.

Section II. TECHNICAL INSPECTION

16. General

This section provides specific instructions for the technical inspection by ordnance maintenance personnel of the telescope mounts M23, M28, M31, M32, M42, M46, M52C, M52D, M54, and M71 in the hands of troops and inspection prior to disassembly when received in field or depot maintenance shops for repair or in the hands of troops alerted for oversea duty. Also, this section amplifies the general instructions in TM 9–1100, insofar as the instructions pertain to inspection of the telescope mounts.

17. Prescribed Inspection Standards for Telescope Mounts M23, M28, M31, M32, M42, M46, M52C, M52D, M54, and M71

a. Completeness and Appearance. Check for completeness and general appearance. The painted surfaces will not have any bare spots, scratches deep enough to expose bare metal, or chipped or loose paint. There will be no signs of corrosion.

b. Holder Assembly. The clamping screw (fig. 11) in the holder assembly of telescope mount M42 will turn freely; the clamping bolts on the holder assemblies of the other mounts will turn freely.

c. Clamping Screws. The clamping screws (fig. 10) will open and close freely without undue looseness or friction. When the clamping screws are tight, they will lock the worms firmly in position.

d. Locking Screws. When the locking screws adjacent to the adjusting screws on the telescope mount M42 (fig. 11) are tight, they will lock the mount firmly in position.

e. Adjusting Worms (Screws on Telescope Mount M42). With the locking screws loose, the adjusting screws on the M42 (fig. 11) and the adjusting worms (fig. 10) on the other mounts will turn freely throughout their entire range of movement.

f. Knob Movement (Telescope Mounts M23, M28, and M31). Turn the knob on the M23 (fig. 1), M28, and M31 (fig. 7) slowly; the movement will be smooth and even.

g. Support and Adapter Threads (Telescope Mounts M23 and M42). The threads on the support of the M23 (fig. 1) and adapter of the M42 (fig. 11) will be free from nicks and burs and the threads will not be crossed or damaged.

h. Instrument Light Clamp Assembly. The instrument light clamp assembly will not be bent or twisted. The clamping nuts will work freely and the hinges will open and close properly without binding.

i. Gear Train (Telescope Mount M32). The gear train on the M32 (fig. 4) will be free of nicks and burs and will turn smoothly without backlash.

18. Additional Inspection Standards for Telescope Mounts M52C and M52D

a. Numbers and Indexes. All engraved lines, numbers, and indexes will be clear and distinct.

b. Elevation Worm Knob. The elevation worm knob (figs. 12 and 13) will turn smoothly and evenly over the entire range of movement. A wobbly knob or a movement that is alternately tight and loose at each half revolution usually indicates a bent worm shaft. Upon reversal of the worm, there will be no appreciable free movement of the worm without corresponding movement of the driven member.

c. Azimuth Worm Knob. The azimuth worm knob (figs. 12 and 13)

will turn when medium pressure is applied. The spring-loaded detent will produce a click at every one-hundredth of a degree position.

d. Cable Insulation. The insulation on the cable assemblies (figs. 12 and 13) will be free from mold, breaks, abrasions, and exposed wires.

e. Cable Plugs. The plugs on the cable assemblies (figs. 12 and 13) will fit and lock properly in their respective sockets. The plugs will not be corroded, deformed, or loose on the cables.

f. Lamp Switch. When connected to a 6-volt power source, the switch will function properly and the lamp will light when the switch is in the ON position.

19. Inspection of Telescope Mounts in the Hands of Troops

a. General. The inspection procedures and standards listed in *b* through *e* below apply to all telescope mounts. Personnel making these inspections will acquaint themselves with the malfunctions indicated in paragraph 21, which are the most common deficiencies of the telescope mounts. In general, if the telescope mount is complete and performs its intended function properly, if all modification work orders classified as urgent have been completed, and if all defects as disclosed by the inspection have been corrected, the telescope mount may be considered serviceable.

b. Inspection of Mechanical Parts.

(1) *Completeness.* Inspect for missing bolts, pins, screws, and rivets. Check legibility of name, instruction, and caution plates. Inspect mounting screws for damaged or stripped heads.

(2) *Appearance.* The appearance of the telescope mount will indicate its general condition and will reflect the type of treatment it has received. Dented surfaces, bent or broken parts, fungus growth, moisture and corrosion, and/or evidence of damage or misuse will indicate need for repair.

(3) *Functioning of mechanical components.* Mechanical components must operate smoothly without binding or rough motion. Parts must be free from grit and must be properly lubricated. Check all worm mechanisms for backlash in the manner described in (*a*) through (*d*) below.

(*a*) With a telescope mounted and a distant target selected for a reference, scribe coincident lines (fig. 14) on the worm knob or head and body.

(*b*) Proceed by turning the worm one and one-half turns in either direction from the scribe marks. Then turn the worm slowly back until the reticle of the telescope comes back on the target. Do not overpass the target and do not change direction of worm movement.

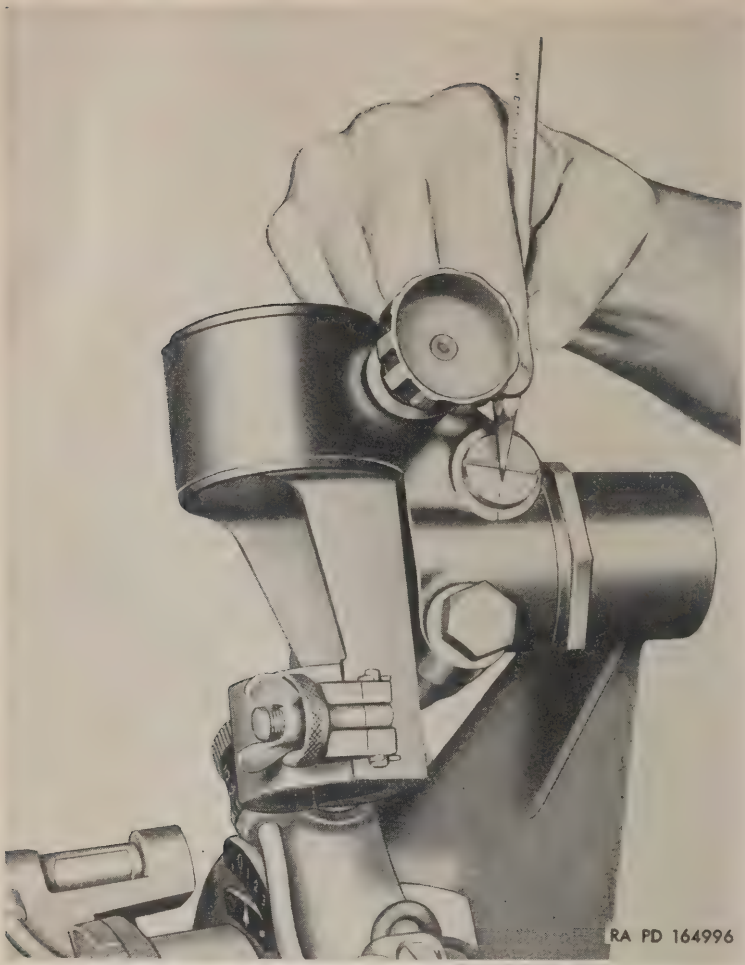

Figure 14. Scribing coincident lines on the worm head and body.

(*c*) Record the differences in the scribe marks. Repeat the procedure in both directions several times. Each time record the displacement of the scribe marks. The mean of the scribe mark recordings will be the amount of backlash.

(*d*) Blacklash shall not exceed the following limit: elevation and azimuth, 0.5 mil ($^1/_{16}$ inch) measured on the edge of the worm knob or head.

(4) *Modification work orders.* All urgent modification work orders must have been applied. Check on application of all

authorized modifications, to see that no unauthorized alterations have been made or that work beyond the authorized scope of the unit is being attempted. The following modification work orders are considered mandatory as of this printing; however, also check the index in SR 310–20–4 and the current modification work order files for any modification work orders promulgated subsequent to this printing.

MWO ORD F197–W3—To provide support for instrument light.

MWO ORD F224–W1—To provide support for instrument light.

(5) *Forms and reports.* Authorized forms and reports for technical inspections are prescribed in TM 9–1100. For additional authorized forms and reports for field and depot maintenance, see appendix.

(6) *Nameplates, scales, and indexes.* Inspect scale numbers, divisions, and indexes and lettering on name, direction, and caution plates, to see that they are clearly defined and easily read.

(7) *Paint and finish.* Inspect for bare spots or damaged finish that expose base metal surfaces and lead to corrosion. If finish is badly damaged, a complete refinishing is necessary. The proper finish can be determined by referring to TM 9–2851 or TM 9–2602.

(8) *Lubrication.* Bearings, sliding surfaces, hinge joint latches, and other movable parts will be clean, properly lubricated, and free from rust and other foreign matter (see TB 9–2835–1).

(9) *Spare parts and equipment.* Inspect for completeness and serviceability. Check the pertinent ORD 8 SNL's listed in the appendix for completeness of materiel and equipment.

c. Inspection of Electrical Components. All scales of reticles and level vials (telescope mounts M52C and M52D) must be properly illuminated, so that they may be seen under all types of light conditions. Electrical connections must be tight and conduits must be free of all breaks or bare spots in the insulation that might cause shorts or grounds. Check all contacts and contact surfaces for the presence of foreign matter, such as dirt, mud, and corrosion.

d. Inspection and Testing Equipment. Authorized fixtures and an instrument repair kit containing the necessary tools, oils, cements, etc., are furnished field inspectors. The instruments discussed herein are of such a design that no other special testing equipment is needed for field inspection.

e. Performance Test. The performance test for the telescope mounts varies with each mount according to its function and on-carriage placement. They should be tested accordingly. See operation procedure in the pertinent technical manual and chapter 4.

20. Ordnance Shop Inspection

a. General. Technical inspection performed by the ordnance repair shop upon receipt of materiel turned in for repair determines the extent of repairs and provides the basis for requisitioning the parts, assemblies, or supplies necessary to accomplish the repairs. Often this inspection in the shops may be the same as that performed by inspectors in the field or will disclose additional necessary repairs not indicated by the using organizations (see TM 9–2602 and FM 9–10).

b. Inspection. For tolerances and standards of the telescope mounts and other inspections, see chapters 4 and 5.

21. Troubleshooting

Troubleshooting is a systematic isolation of defective components by means of symptoms, tests for determining the defective components, and remedies. The tests and remedies provided herein are governed by the scope of the level of ordnance maintenance.

Table III. Troubleshooting

Malfunction	Probable causes	Corrective action
Binding and rough movement in worm mechanisms.	Ball cap too tight	Loosen the ball cap screw till relieved.
	Plunger, worm, socket, or ball cap scored or burred.	Correct by lapping or stoning (pars 37, 38, and 39).
Instrument lights fail to operate when switch is turned on.	Loose or burned out bulb, battery burned out or swollen due to corrosion, defective wiring or switch.	Check and replace items that are defective.
Worm binds	Worm threads crossed	Replace worm and check worm gear. Replace if necessary.
	Worm bent	Straighten or replace.
Clamping screws do not hold worms in positive grip.	Stripped or damaged screw threads.	Replace all damaged screws.
Ball socket does not seat properly in housing.	Worn or broken point on the special headless dog-point screw.	Replace the screw.
Mount is hard to operate in cold weather.	Too much grease in worm housing.	Remove worms and clean with volatile mineral spirits or dry-cleaning solvent. Apply a thin coat of the proper aircraft and instruments grease (ORD 3 SNL K–1) to all parts.

22. Preembarkation Inspection

a. Inspection of outward appearance of the telescope mounts is of importance as well as inspection of mechanical condition.

b. Where any doubt exists as to the utility of an assembly or of the telescope mount, that assembly or telescope mount must be replaced by a truly serviceable item. Equipment, when inspected, must approach new equipment standards of operation and appearance, and the workmanship and quality of the end product must reflect the highest standards obtainable. To assure that all items, insofar as practicable, possess original appearance, it is desired that items normally painted be repainted if the painted surfaces show signs of damage.

c. The specifications, standards, and operations intended as a guide to insure satisfactory performance and acceptability of the telescope mounts are indicated in chapter 4. The inspector should check the reports and daily records, operator's forms, and manuals for determining the extent and amount of wear of component parts.

CHAPTER 4

REPAIR AND REBUILD

Section I. GENERAL MAINTENANCE

23. General

a. Information and instructions contained herein are supplementary to instructions for the using organizations contained in the pertinent operator's technical manual.

b. This chapter contains general and specific maintenance instructions for the repair and rebuild of each major component. In paragraphs 34 through 247 specific adjustments, repairs, and rebuild procedures are described, in order to restore each major component to a serviceable condition.

24. General Methods

a. Handling of Disassembled Parts. A parts tray or suitable receptacle should be provided so that parts, as removed, can be placed in respective positions in relation to the assembled telescope mounts. Always keep the relative position of parts until the telescope mount is completely assembled. This is especially important where the materiel is assembled by a technician other than the one who disassembled it.

b. Scribing Metal Parts. As each part is removed, its exact position in relation to the assembly should be established by suitably scribed reference marks, if it is necessary to return it to its exact original position. Never scribe marks on threads or bearing surfaces. When removing mating gears, scribe each gear and assemble in the same position.

c. Removal of Burs. For removal of burs on the threads, screw heads, and working parts, such as gears or shafts, a jeweler's file (Swiss file) or pumice stone should be used.

Caution: Care must be exercised to prevent the removal of more metal than is necessary when filing.

d. Removal of Corrosion or Rust. Rust and corrosion should be removed with fine crocus cloth.

25. Cleaning of Metal Components

It is necessary that metal parts be cleaned before they can be properly lubricated and assembled. Cleaning retards chemical decomposi-

tion and premature deterioration. It minimizes the possibility of rust. Parts improperly cleaned may allow dirt, dust, and other foreign matter to get into the interior of the instrument where they may cause serious damage.

a. Ordinary Cleaning. In ordinary cleaning operations, immerse the parts to be cleaned in volatile mineral spirits or dry-cleaning solvent.

Caution: Volatile mineral spirits and dry-cleaning solvent are inflammable and should not be used near an open flame. Fire extinguishers should be provided when these materials are used. Use only in well-ventilated places. The use of gasoline or benzene (benzol) for cleaning is prohibited.

Clean with a stiff-bristled brush, the size of which will be determined by the size and nature of the part being cleaned. Remove the parts from the solution. Dry thoroughly with lintless cloth or air and install as soon as practicable. Always be sure that the solution is clean to start with. Never allow it to become saturated with old oil, grease, or dirt. Change the volatile mineral spirits or dry-cleaning solvent frequently.

b. Heavy Oil Removal. Heavy oil and grease can be removed by the use of cleaning compound (see ORD 3 SNL K–1 and TM 9–850). Cleaning compound is usually used for the cleaning of parts that have been heavily coated with rust-preventive compound or heavy grease. For cleaning caked grease from metal parts, a water solution of the cleaning compound is placed in a tank, preferably heated by a steam coil. The parts are then placed in the tank and boiled for 10 minutes or longer.

Note. Cleaning compound should not be used for small and delicate parts.

c. Removal of Paint and Varnish. For removal of paint and varinsh, see TM 9–2602 and TM 9–850.

26. Lubrication

a. General. Lubrication of most fire control materiel should be performed very carefully, since even a very slight amount of overlubrication often will render an item unfit for use. Excessive lubricant may congeal and render close fitting parts inoperative.

b. Lubrication of Components. All metal components will be lubricated with aircraft and instruments grease at the time of assembly. Paint a thin film of grease on the components. Do not overlubricate.

c. Grease and Oil Fittings. All grease and oil fittings, if any, on telescope mounts in this manual will be permanently removed and the holes permanently plugged (TB 9–2835–1). While the mount is disassembled, remove the fitting and tap the holes. Make threaded brass

plugs; screw them in tightly and stake in place. Saw off the protruding part of the plug and blend in with the surface of the casting. Care should be exercised, so that the plug does not protrude inside housing or other parts where moving components are present.

27. Taper Pins and Tapered Holes

a. General. A taper pin may be defined as a metal rod with a diameter that decreases uniformly. Taper pins are used to secure one part to another in a positive relation to each other, such as the securing of a knob to a shaft.

b. Numbering System. In order to insure uniform size and shape of taper pins, the Ordnance Corps has set up certain standards, establishing that all taper pins will be tapered similarly (one-fourth of an inch per foot) and that certain diameters will be identified with numbers. All pins with the same number would then have the same maximum diameter; therefore, the longer the pin (of any one number), the smaller the minimum diameter.

c. Preparation of Work to Receive Taper Pin. When preparing work to receive a taper pin, a hole must be drilled, then reamed with a taper reamer. The larger the drill used, within the scope of the taper, the less reaming will be required. Before drilling any hole for a taper pin, therefore, it is necessary to know the minimum diameter of the pin to be used, so that a drill may be selected accordingly. TM 9–2820 may be consulted for drill selection. When the proper drill has been selected, the hole should be drilled, then reamed with a taper reamer of the correct number.

28. Precautions Before Installing Taper Pin

Before securing two parts with a taper pin, always check the direction of the taper. Slip the pin loosely in the hole from either side. It should be driven into the side in which it enters most deeply. When securing two parts, which have been previously drilled and reamed for a taper pin, such as a worm shaft and knob, check the direction of the taper in both parts and assemble accordingly. The parts should have been marked during disassembly, to eliminate any guesswark. Failure to follow the practice of checking the direction of taper in the parts may cause damage to the parts when the pin is driven in and possibly make the instrument unserviceable. For example, assume that a taper pin is inserted into a knob-hole when the shaft is not in the proper position but reversed: Instead of properly checking the taper, the pin is driven into the hole. As a result, the shaft becomes damaged to the extent that the proper size pin will no longer fit. The head of the pin becomes mushroomed in the attempt to drive it into the proper depth. When the repairman attempts to drive out the same pin, the small end will become burred, because of the tightness of the pin, and the pin may have to be drilled out. Some

difficulty will thus be encountered in turning the knob on the shaft after the drilling operation. It pays to check the hole carefully before attempting to install a pin.

29. Installation of Taper Pin

To install a taper pin, first be sure that the hole is properly alined as outlined in paragraph 28. A clean hole and a well-matched pin should fit together within one-sixteenth of an inch of the final position. If this is not true, check the pin for burs and the hole for poor alinement of parts. When the pin is in place properly, one sharp tap on the pin with a brass hammer (fig. 15) is all that is needed to drive it into its final position. If a brass hammer is not available, an ordinary hammer and a brass punch may be used.

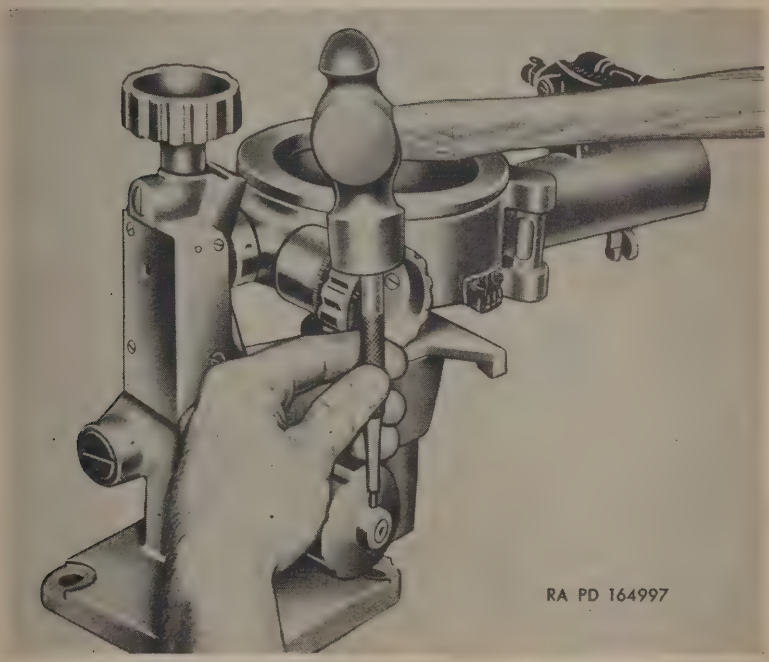

Figure 15. Installing taper pin.

30. Removal of Taper Pin

To remove a taper pin, look to determine which is the smaller of the two ends. Then remove the pin by one of the methods described in *a* and *b* below.

a. If both ends of the pin are exposed, one sharp blow on the small end of the pin with a soft hammer is all that is usually necessary.

b. If both ends of the pin are below a surface, select a punch slightly

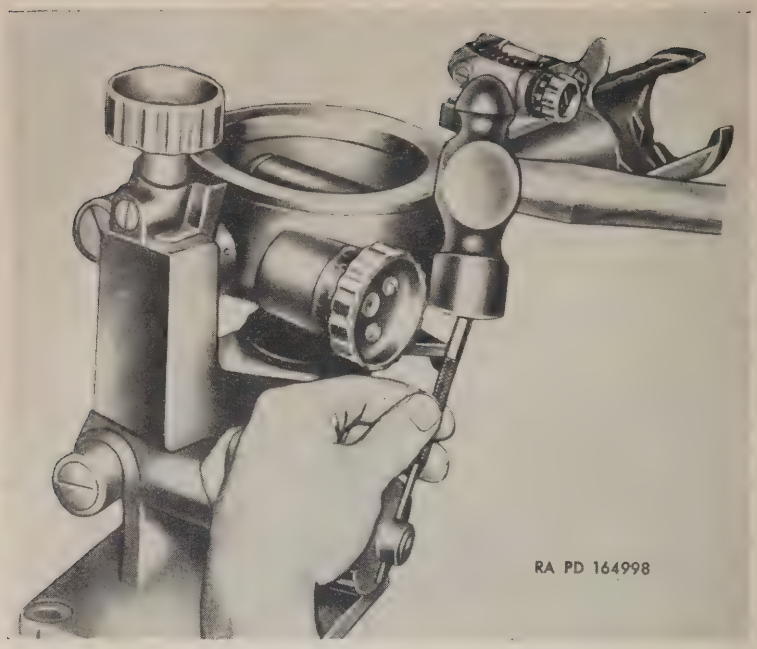

Figure 16. Removing taper pin.

smaller in diameter than the small end of the pin. Be sure that it is a straight pin punch and not tapered. Place the punch against the small end of the pin and strike it with one sharp hammer blow (fig. 16). Such a blow will usually remove the pin, whereas several haphazardly struck blows will damage it. Determine the size of the hammer according to the size of the job.

31. Reconditioning Damaged Tapered Holes

When the tapered hole has become damaged because of reasons given in paragraphs 28 through 30, the hole must be reconditioned before a pin can be installed. The reconditioned hole and the new pin will, in most cases, be one size larger, because of the material removed from the hole. As in the case of a new hole, the repair will involve drilling and reaming. Aline the tapers of both parts and secure the assembly on the drill press with the hole perpendicular to the drill press table. Select the proper size drill that will be necessary to provide a hole of the next larger size. Check the drill for centering in the hole and drill. Ream out the hole with the proper size taper reamer. Check to see how far the pin drops into the hole, then touch up the hole with the reamer until the pin seats properly.

32. Abrasives and Abrasive Processing

"Grinding," "honing," and "lapping" are terms that refer to the removal of metal by the use of an abrasive. The major differences between these processes are described in *a* through *c* below.

a. Grinding is a complete process in itself, in which an abrasive wheel is used.

b. Honing is a hand or machine process (used mostly on internal surfaces), where only a small portion of the metal is to be removed (0.0005 to 0.002 inch). Honing must follow other machine operations, such as cutting and grinding.

c. Lapping is a final operation and is used by the instrument repairman for accurate fitting of mating parts. Descriptions of the lapping compound and lapping process are given in paragraph 33.

33. Lapping

a. General. Lapping is an operation for removing a small amount of metal with an abrasive compound either by hand or machine. Not more than 0.0005 inch of metal should be left on the piece to be removed by lapping. Lapping produces a smooth, but not necessarily polished, surface that is not usually obtainable through ordinary machine and hand operations, such as turning, thread cutting, filing, etc. Lapping must be performed, therefore, to finish properly such bearing surfaces as plungers, worms and gears, ball caps, ball sockets, etc. Machine lapping is not normally within the field of work for the instrument repairman, since it is used chiefly in production work.

b. Lapping Compound. The abrasive mixture used in the lapping process is known as the "lapping compound" and must be mixed by the instrument repairman. It is composed of ground pumice and lard oil. The pumice comes in two grades; medium and fine. In most cases, the amount used in an operation is quite small. It is suggested, therefore, that only a small amount be mixed at a time, so that it will not be left on the bench to pick up dirt, filings, etc., which might cause damage in the lapping operation. A mixture of the two ingredients to about the consistency of paste is adaptable for most operations.

c. Lapping Procedure.

(1) In the lapping process, particularly in the case of soft metals, some of the abrasive particles may become embedded in the metal and will not "wash off." An undesired cutting action may thus result when the part is again in use; consequently, select a compound that will resist the tendency to embed itself in the metal. The following list will be useful in making such a choice:

Metal	*Compound (Grade of pumice)*
Steel on steel	Medium and/or fine
Steel on brass	Medium and/or fine
Brass on brass	Medium and/or fine
Aluminum on aluminum	Fine

(2) Apply the compound sparingly to the parts to be lapped, then work the parts together until they are perfectly mated. Frequent inspection should be performed to prevent the removal of excess material, thus causing possible spoilage. After lapping has been accomplished and before each inspection, the parts must be washed off thoroughly. Volatile mineral spirits or dry-cleaning solvent may be used. The washing-off process must remove every trace of abrasive; otherwise, the cutting action will continue as the parts are worked together in use.

(3) The fact that a movement binds or chatters is not always an indication that lapping is necessary. Disassemble, wash, and thoroughly inspect the parts before lapping. It is possible that inspection will reveal a small bur, which may be easily removed with a file, scraper, or oilstone. A good cleaning, followed by proper lubrication, may also be enough to smooth out a movement.

Section II. MAINTENANCE OF COMMON MECHANICAL ELEMENTS

34. Worm and Worm-Gear Mechanisms

a. General. The worm and worm gear principle is widely used in fire control instruments as a means of rotating an instrument in azimuth and in elevation. This principle has been adopted as the standard for mechanical movements in almost all rotating instruments. Before proceeding with any maintenance work in connection with this type of mechanism, all maintenance work for the worm shaft, as given in paragraph 35, must be thoroughly understood and, if necessary, accomplished.

b. Equipment Needed for Repair.

Instrument repairman's tool kit.
Lapping compound (par. 33).
Cleaning materials and cleaning equipment (par. 25).

35. Maintenance of Worm Shaft

For a worm shaft to operate properly, the shaft itself must be absolutely true and straight, so as to prevent the worm from being thrown off center at each revolution of the shaft and causing a binding movement in the worm and worm-gear mechanism. If such binding occurs, it is frequently due to a bend or, more often, several bends in the shaft. In such cases, the entire worm shaft should be replaced. It may sometimes, however, be necessary to try to locate and straighten these bends. This process involves much skill and the ability to select from a wide variety of methods those best suited to the particular

condition found. No specific procedure can be outlined. Generally, the entire length of the shaft must be continually tested during the straightening process, and the shaft must be straightened to a point where the worm thread will be no more than 0.001 inch off center when the shaft is rotated in its bearings. Care must be taken to avoid damaging the worm thread of any of the bearing surfaces while straightening the worm shaft.

36. Maintenance of Ball on Worm Shaft

The worm shaft ball plays an important part in obtaining a smooth, nonbinding movement free from backlash, and the ball, therefore, must be perfectly round. An out-of-round ball provides a poor bearing surface and will cause binding in the throwout mechanism, besides being a source of backlash trouble. To true an out-of-round ball without removing an excess amount of metal, use a ball truing tool, as shown in figure 17.

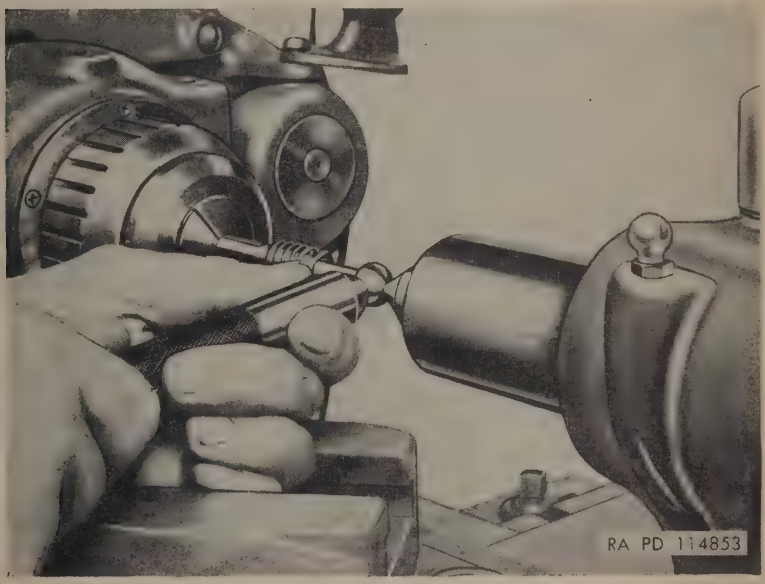

Figure 17. Use of ball truing tool.

37. Fitting Ball Cap and Socket to Ball

a. See that the spherical bearing surfaces on the ball cap and ball socket have been relieved, as shown in figure 18, before fitting these parts to the ball. If this is not done, the adjustment of the ball cap becomes very critical. Too much bearing surface on these parts tends to lock or bind the worm shaft movement when the ball cap is brought against the ball. Relieving the bearing surface reduces the

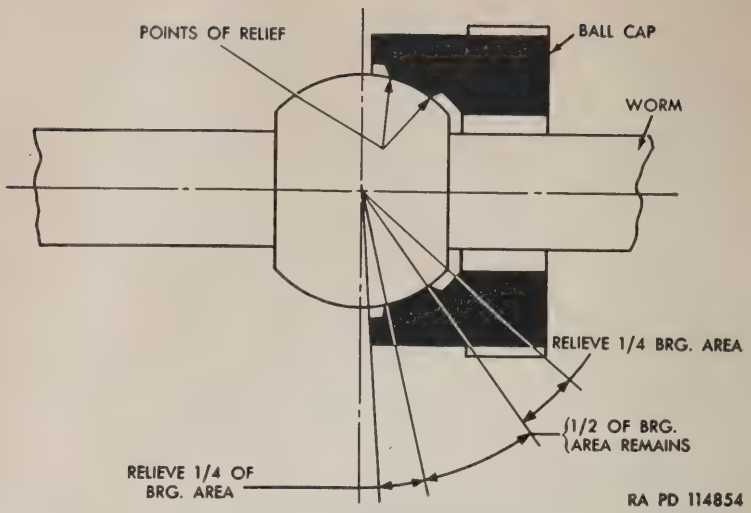

Figure 18. Points of relief on ball cap.

tendency of these parts to lock themselves on the ball, and the adjustment of the ball cap becomes less critical. Do not cut away more than one-half of the bearing surface, since too little bearing surface will cause rapid wear with consequent backlash.

b. The initial fitting is performed by placing the worm shaft in a lathe collet and applying lapping compound (fine pumice) to the ball. Both ball cap and socket are then slipped onto the shaft and held together around the ball while the lathe is turning at a slow speed. This lapping process should continue until a good bearing surface is shown on the ball cap and socket. The ball cap and socket must then be cleaned (par. 25) and assembled in the instrument with a very fine film of the same lapping compound on the ball. The worm shaft is then turned about six times to perform a "finish" lapping. Then, the assembly must again be removed and cleaned thoroughly. The bearing surfaces should now show a smooth, satin finish. If so, further polishing or burnishing of the parts is unnecessary.

Caution: Do not lap ball caps or sockets having plastic inserts.

38. Fitting Plunger to Housing

The plunger must fit in the housing without any sideplay. If it fits loosely, the worm shaft will have sideplay that will appear as backlash. In order to facilitate handling of a new plunger when fitting, select a piece of brass or steel rod a little larger in diameter than the spring hole in that plunger and turn a slight taper on the end of it. Then, force the plunger tightly on the rod. The rod must not turn within the plunger. Lap the plunger in the housing, so that

the plunger will be free enough to move smoothly up and down when a slight finger pressure is exerted against it.

39. Fitting Plunger to Worm Shaft

a. The worm shaft must fit in the semicircular bearing surface of the plunger without any sideplay. If sideplay is present, this will appear as backlash, as in the case of a loose-fitting plunger. Before lapping in, relieve the center portion of the semicircular bearing, as showing in figure 19. This is done so that the worm shaft will wear itself in deeper, reducing the possibility of developing sideplay.

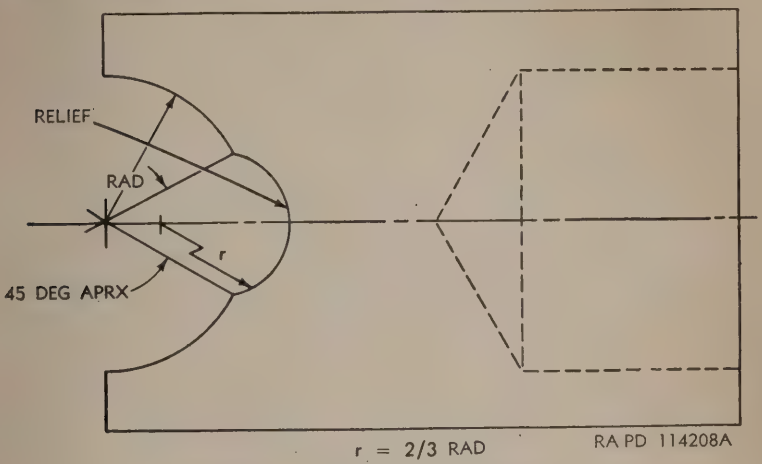

Figure 19. Point of relief for plungers.

b. Mount the worm shaft in the housing and adjust the ball cap, so that there will be no endplay in the shaft. Apply a thin coating of lapping compound (fine pumice) to the semicircular bearing surface of the plunger, then insert the plunger into the housing. Insert the plunger spring. Screw in the plug until it is flush with the surface of the housing. Lap in by turning the worm shaft a few turns in each direction. Remove the plunger and clean it in volatile mineral spirits or dry-cleaning solvent, so that the bearing surface can be observed. Lap until complete contact of the worm shaft on the semicircular bearing surface of the plunger is indicated. After lapping is finished, remove the plunger and worm shaft and clean thoroughly. Assemble into housing and check for sideplay.

40. Fitting Worm to Worm Gear

a. Before lapping is started, always clean the parts thoroughly (par. 25) and examine the teeth for nicks, burs, and sharp edges. If a new worm is to be installed, place the worm in a lathe chuck, and,

with the lathe running at slow speed, file a slight radius on the corners of the worm thread. Whether a new or old worm is used, it is always best to check the gear mesh before lapping is started. Wipe a fine coat of Prussian blue on the worm thread and assemble the instrument. Turn the worm over the entire range of movement, then disassemble. Check for high spots, bottoming, etc. Scrape off the high spots. If an old worm is bottoming in the worm gear, set the worm up in a lathe and turn off about 0.010 inch from the outside diameter of the worm thread. Check again to insure that the worm is not bottoming in the worm gear.

b. If a new worm bottoms in the worm gear, then the worm-gear teeth are worn excessively and a new worm gear should be installed. When the bearing of a new worm in an old worm gear is checked, it may be found that the new worm is riding on the corners of the worm thread, because the old worm has a larger radius on the corners. Do not increase the radius on the new worm. Examine the corners of the worm-gear teeth. If there is a visible ridge, scrape it off with a three-cornered scraper. If no ridge is visible, proceed to lap in the worm until an even, smooth movement is obtained and the bearing is shown on the sides of the worm and worm-gear teeth. When lapping worm and gear, better results will be obtained by removing the spring behind the plunger and installing a solid plug. In this manner, any minute high spot that might be rolled over will be removed, thus increasing the perfection of the fit. After lapping is finished, place the worm shaft in a lathe and increase the radius on the corners of the worm thread. This is done so that, as the movement wears, the worm will move in without developing a bearing on the corners of the thread. A corner bearing will prevent the worm from moving into proper mesh and backlash will develop.

41. Backlash

a. General. Backlash is one of the main factors contributing to the malfunctioning of the moving mechanical parts in fire control instruments. It is freeplay or movement of the driving member without corresponding movement of the driven member. The total absence of backlash is the ideal condition for fire control instruments. It is well known, however, that small amounts of backlash must be present in order to obtain smoothly functioning and operable mechanical movements. Tolerance limits for backlash have, therefore, been established for the various instruments (par. 19*b*(3)). There are many causes for backlash. The most prevalent are looseness in gear meshes, endplay in shafts, sideplay in bearings, and binding in bearing surfaces. In many cases, it will be found that total backlash is a result of combinations of these causes.

b. Inspection for Backlash. The inspection for backlash (par. 19)

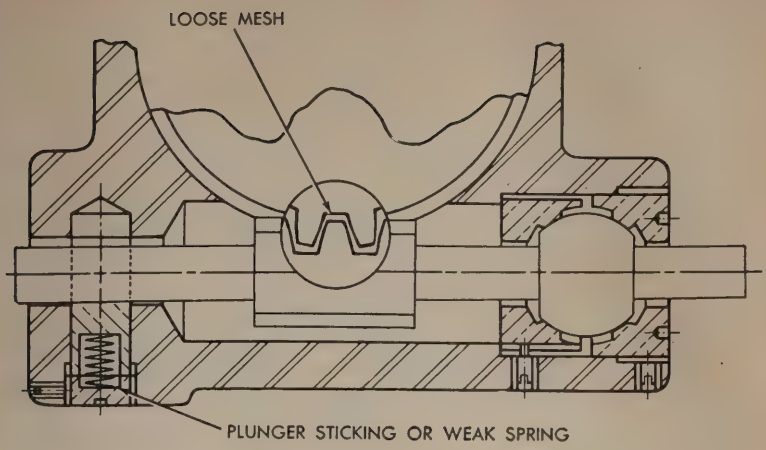

Figure 20. Plunger sticking or weak spring.

in fire control instruments is primarily a means for determining the angular distance through which the driving member of a mechanism, e. g., a worm, moves before causing a movement of the driven member, e. g., a worm gear.

c. Looseness in Gear Meshes. This type of backlash is due to the slack or looseness between the mating members of a mechanism. To use the example of the worm and worm gear, a close mesh of the worm with the teeth of the worm gear is obtained by means of pressure against the worm shaft from a spring and plunger. If the teeth are not firmly in mesh, there may be rotation of the worm without a corresponding movement of the worm gear. This condition may be due to a weak plunger spring that does not force the worm all the way in or that permits it to ride out instead of turning the worm gear (fig. 20). It may be due to burs or irregularities on the plunger or its housing that do not permit the plunger to bear strongly on the worm shaft. It may be due to the fact that the worm and worm gear are so badly worn that the worm shaft bears on its housing, and the worm is thus prevented from meshing fully with the worm gear. The lost action, or slack, may also result from "bottoming," which prevents full mesh of the teeth. "Bottoming" is the condition that exists when the crests of the teeth of one member bear in the troughs of the other (fig. 21).

d. Endplay. "Endplay" is the term applied to lengthwise movement of a shaft (fig. 22). Such movement, in a moderate degree, is acceptable when it does *not* contribute to the total backlash. Shafts are normally restricted longitudinally by shoulders, collars, thrust bearings, ball caps, and sockets or by a combination of these. Ball

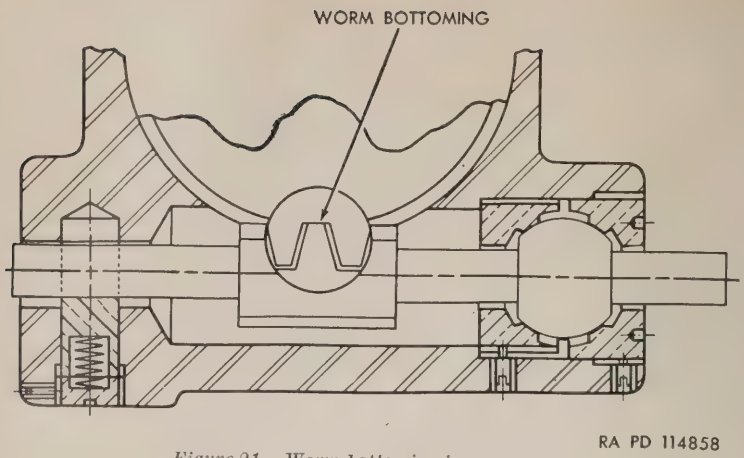

Figure 21. Worm bottoming in worm gear.

caps and sockets and worm-shaft balls are commonly used for this purpose in military instruments, the worm-shaft ball being held between the ball cap and the socket. If the ball cap is loose and the ball socket does not bear firmly and uniformly upon the ball, endplay in the shaft will result. As the worm shaft is rotated, the slack between the ball and ball cap or socket must be taken up before the shaft will cause the worm gear to rotate.

e. Sideplay. "Sideplay" is the looseness or lateral movement that is found in improperly fitted or worn bearing parts. Such movement should be reduced to an absolute minimum, since it affects total backlash.

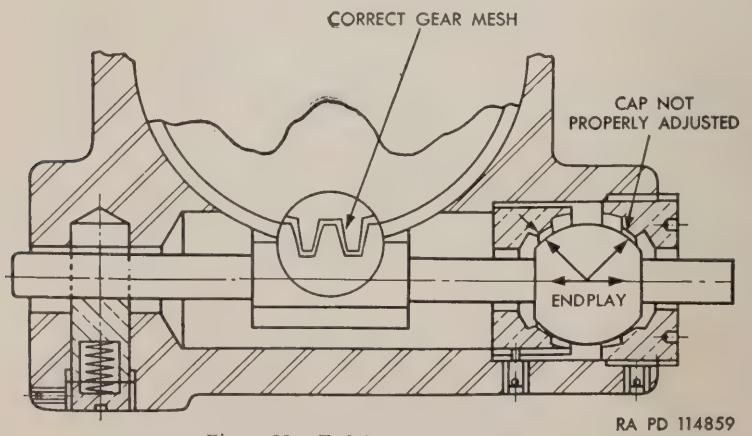

Figure 22. Endplay in worm shaft.

f. Backlash Due to "Binding." This form of backlash occurs in screw-type adjustments, which depend upon steady spring pressure to eliminate lost motion or slack.

g. Reduction of Backlash. On worm and worm-gear mechanisms, backlash may be reduced by tightening the ball cap against the worm-shaft ball. Backlash may sometimes be reduced by replacing the plunger spring. In cases of emergency only, the spring may be "shimmed." Backlash may be eliminated by removing irregularities from the plunger that might prevent its movement or by filing away or relieveing the shaft housing, if the shaft bears against it. Bottoming of the worm may be eliminated by turning off a small amount of metal from the worm or worm gear.

42. Chatter

A chattering movement is usually an indication of a tight ball cap. If adjustment of the ball cap does not cure the trouble without producing excessive backlash, the trouble is elsewhere. The ball cap and socket may not be properly relieved, in which case, these parts will grip the ball tightly as soon as the ball cap is touching the ball. The ball may be out of round, or the ball cap and socket may not be properly lapped in. The plunger spring may be too tight or the worm not lubricated. The dog-point setscrew, which keeps the ball socket (fig. 23) from turning in the housing, may be tight against the socket. The socket is a floating fit in the housing i. e., the outside diameter of the socket is about $\frac{1}{64}$-inch smaller than the diameter of the bore in the housing. When the ball cap is brought against the ball, the socket will center itself on the ball, unless the dog-point screw prevents it from doing so. When the socket is placed in the housing, see that the dog point is in the groove in the socket and that the socket

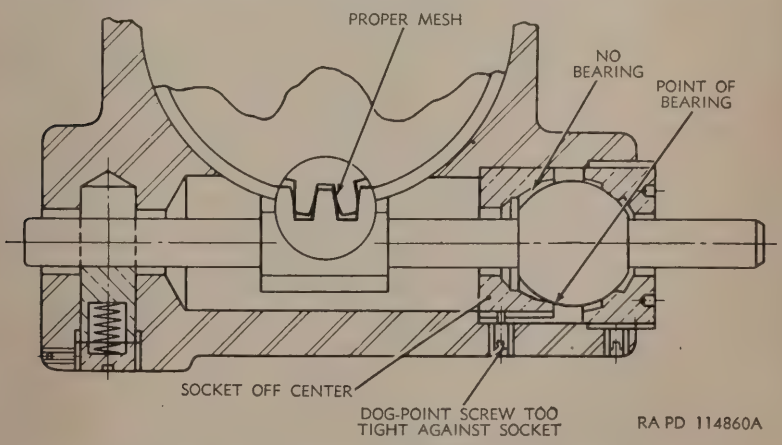

Figure 23. Dog-point screw tight against socket.

is free to move from side to side in the housing. After the ball cap has been properly adjusted against the ball, screw the dog-point screw in until it touches the socket, then back it out about one-quarter turn. If the screw is tight against the socket, it is forcing the socket off center, thereby producing a rough or chattering movement.

43. Clicking

a. This is something that can be felt when the worm knob is held between the thumb and forefinger and turned back and forth a few mils. Every time the rotation of the knob is reversed, the movement is loose for a short distance (1 to 3 mils) until a click or bump is felt in the knob when the lost motion has reached its limit. The reason for this is that, the dog-point setscrew is fitting loosely in the threads in the housing, or the dog point fits loosely in the groove in the socket, or a combination of both (fig. 24). Every time the motion of the knob is reversed, the socket will move in the housing until the dog-point screw has cocked over to the other side. Once it is started, this clicking will grow progressively worse. This condition cannot be permitted to exist, because the loose spot is always at the setting point. Turn the knob in the opposite direction from which it was brought to the setting point, or fire the gun, and the instrument will be "off" the target. This loose spot in the movement is *not* lost mo-

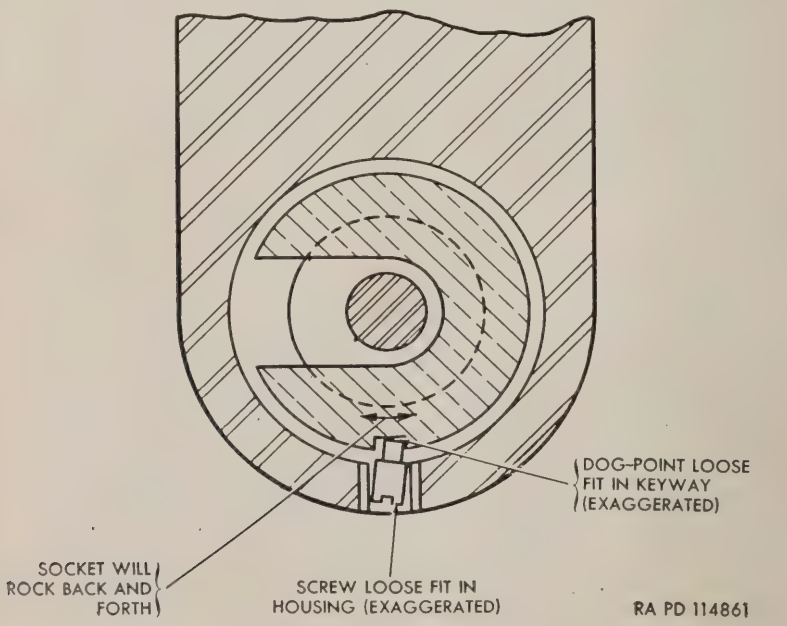

Figure 24. Dog-point screw loose in threads in housing.

tion that affects the accuracy of the instrument, but it makes the instrument unreliable, because it will not hold a set reading. If this condition is found in an elevation or cross-leveling movement, watch the level-vial bubble move off center when the knob is moved between the limits of the loose portion.

b. The only remedy for this condition is to install a screw that fits snugly in the housing and make sure that the dog point fits in the slot in the socket. The repairman should never disturb the dog-point screw. When they are properly set, turning these screws in and out serves no other purpose except to work the screw loose in the housing and the clicking condition will result.

44. Binding

A binding or uneven movement is usually caused by a bent worm. Binding may also be due to the presence of dirt between the worm and worm gear or by a bur on one of the teeth. If a bur is present, remove it with a stone, file, or scraper. Polish the area with crocus cloth, lubricate and assemble the parts, then check the movement again.

45. Springs

a. General. Very little can be said about maintenance of springs. When a spring is functioning improperly, it should be replaced with a new one. It is a common mistake to remove a spring and stretch it, because, after assembling, a stretched spring will always return to its original size and strength.

b. Replacing a Spring. When replacing a spring, check the replacement spring carefully for the number of coils, the diameter, and the kind of stock from which the spring is made.

c. Reshaping a Flat Spring. If slight reshaping of a flat-type spring is desired, apply a steady bending pressure until the bent portion has returned to the desired shape. Avoid excessive flexing of the metal. This may easily destroy the spring quality of the metal. A steady bending pressure should be used.

46. Bearings

a. General. If an instrument is declared unserviceable because of a fault in the ball bearings, it is usually due to the lack of lubrication or careless installation of the bearings.

b. Removal and Installation. It is impractical to prescribe detailed instructions applicable to every case of ball and roller bearing removal and installation. If special bearing equipment is available and can be adapted to the job, a minimum of trouble will be experienced. In many cases, bearing removal or installation may be accomplished only by driving with hammer and drift, sleeve, or block. Any tool used to drive bearings should be made of brass; otherwise, the bearing may be severely damaged.

c. Precautions in Removal and Installation.

(1) When removing or installing bearings that require a push fit on one race (either inner or outer), exert pressure on that race only.

(2) If hammer and drift are used, be sure that the drift face is clean and that it is held squarely against the work.

(3) Never apply pressure to bearing raceway surfaces, ball, ball separators, or snap rings.

(4) In all cases, tap as gently as possible and move the tool around the race to prevent denting.

d. Care and Preservation. Lubricate bearings according to instructions given in paragraph 26. When badly rusted bearings have been removed from an instrument or if there is rust on the race, the bearings should be replaced. If the bearing functions properly, but has slight rusty spots, remove the spots by using fine abrasive cloth. After bearings have had the rust removed, they should be degreased, if degreasing equipment is available, or should be washed in mild alkaline cleaning compound solution. Preparation and use of this solution is described in TM 9–850. The alkaline solution will also remove fingerprints, which is not true of the degreaser. If bearings have been degreased in a degreasing machine, ethyl alcohol should be employed to remove fingerprints. After the alkaline bath, the bearing should be rinsed in water and dried in an oven or on a hot plate at a temperature of 190° to 200° F. Cleaned bearings should not be touched with the fingers. After cleaning, the bearings should be lubricated and installed in the instrument. If bearings are not to be used immediately after cleaning, they should be dipped in hot, light rust-preventive compound and wrapped in greaseproof paper, then stored in a dry place until ready for use.

e. Test for Condition of Bearings. After bearings have been thoroughly cleaned, they should be tested by rotation for rough spots in the movement and by minute inspection of the balls and races for pits, corrosion, scoring, or other damage to the surfaces. A test for condition of ball bearings may be made by holding the inner race stationary while spinning the outer race. If the bearing is perfectly clean and undamaged, the outer race will roll freely and smoothly, slowing down without any jerky motion until it stops. The amount of allowable imperfections varies so greatly that, it is considered impracticable to delineate what is, or what is not, serviceable for all functional installations. The field is wide, from the self-synchronous repeater bearings, where no imperfections of the race of balls are permissible, to the large, very slow-moving bearings found in some telescope mounts, which would work satisfactorily even if the bearings were not turning very smoothly.

47. Staking

a. General. Staking (fig. 25) is a process usually employed to secure two parts together. It is not, as is often the case, to be confused with waterproofing of screwheads, etc. Threaded parts that draw up to a certain critical point are sometimes staked to maintain that point. The advantage of staking is that it is an absolutely sure mehod of holding parts together or in final position.

b. Procedure. Various shaped punches may be selected for the staking process. The watchmakers' staking set gives a good example of the variety of selection. Staking should be accomplished with as light taps of the hammer as possible but with a heavy enough blow to prick the work and bring the metal to the desired shape. Use a hammer of moderate weight and a punch with a large included angle point.

c. Precautions. Staking may be difficult for the inexperienced repairman. A great deal of damage may be done to the material being

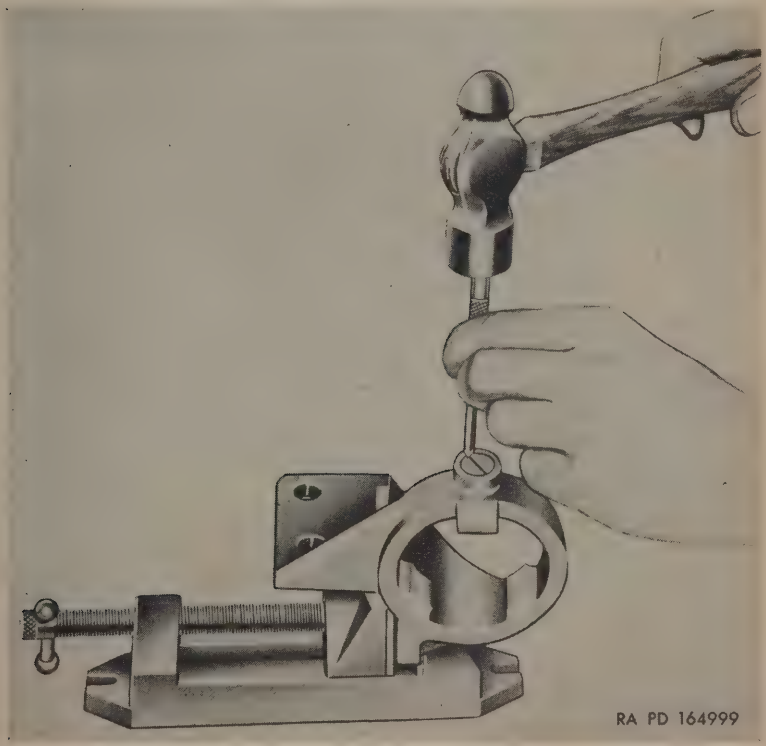

Figure 25. Staking a plug in place.

staked, if the staking is not properly done. Reticle windows are easily broken and tubular parts are easily bent, if the procedure is not followed with extreme skill and care.

48. Peening

a. General. Peening is a method used to move or stretch the surface metal of the work in a definite direction. Probably the best example is the simple "riveting-over" of a bolt to keep the nut from unscrewing. The tools necessary to do a peening job will vary somewhat according to the size and accessibility of the work. The ball, cross, or straight peen hammer or a specially ground chisel is all that is necessary to do a job of peening. The roundness of the working edges or faces of these tools make indentations in the work rather than cuts, thereby moving the metal without destroying it.

b. Preparation for Peening. Most of the preparation for a peening job consists of an analysis of where to do the striking. Spherical indentations are caused by the use of an improperly selected ball peen hammer or peening chisel. Thus, the selection of the proper tool is an important factor in preparation. The parts to be peened must always be "backed up" and the proper tool or holding device must be provided.

c. Procedure. To illustrate, suppose the bearing on a tube assembly has become loosened. It is decided to tighten this bearing by peening the rivets that secure it to the tube. The blows must be so directed as to cause the metal of the rivet to flow, tightening the assembly. The blows should be light and the metal must be flowed slowly and smoothly.

Section III. TELESCOPE MOUNT M23

49. General

This section contains the procedure for the removal, disassembly, and rebuild of telescope mount M23. Test and adjustment and installation of the telescope mount M23 (fig. 1) are also included in this section.

50. Removal From the On-Carriage Position
(fig. 26)

Loosen the hex-head cap screw that clamps the housing support. Support the telescope mount M23 in one hand and, using the proper size wrench, rotate the housing support until it clears the threaded hole on the upper part of the bracket of the range quadrant M4 or M4A1. Remove the telescope mount.

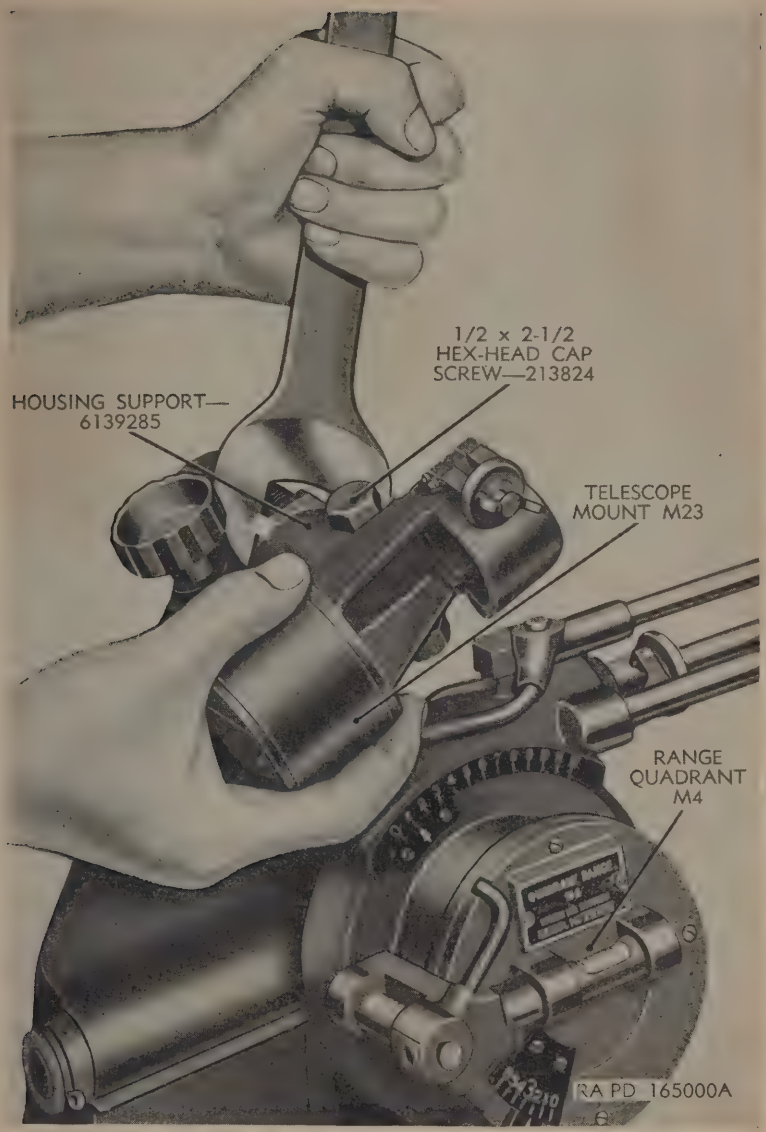

Figure 26. Telescope mount M23—removal from the on-carriage position.

51. Removal of Major Assemblies and Related Parts (fig. 27)

Note. Before commencing with removal and disassembly, see scribing of components in paragraph 24b.

a. Remove the headless setscrew (P) that locks the brass plug (S) in the housing.

b. Unscrew the plug from the housing, using care, as the plug is under tension from the spring (R). Extract the compression spring and worm plunger (Q) from the housing.

c. Support the knob (B), so that the small end of the taper pin that secures the knob to the telescope bracket adjusting worm (E) is on top. Press or drive (par. 30) out the taper pin (A). Pull the knob and felt washer (C) from the end of the worm.

d. Remove the headless setscrew (F) that locks the ball cap in the housing. With a spanner wrench, unscrew the ball cap (D) from the housing.

e. Remove the headless special screw (G) that positions the ball socket in the housing. Extract the telescope bracket adjusting worm (E) and ball socket (T) from the housing. It may be necessary to rotate the worm with the fingers, in order to clear the gearing on the telescope bracket assembly. Slide the ball socket from the worm.

f. Remove the headless setscrew (N) that locks the telescope bracket plug in the telescope bracket assembly. With a spanner wrench, unscrew the telescope bracket plug (M) from the telescope bracket assembly. Pull the telescope bracket assembly (L) from the housing assembly.

g. Unscrew the two round-head screws (H) that secure the instrument light clamp assembly (K) to the telescope bracket assembly. Slide the two lockwashers (J) from the two screws. Lift the instrument light clamp assembly from the telescope bracket assembly.

52. Disassembly of the Instrument Light Clamp Assembly (fig. 28)

a. Press or drive out the straight pin that secures the thumb nut assembly to the bracket. Separate the thumb nut assembly from the bracket.

b. Press or drive out the straight pin that secures the clamp to the bracket. Separate the clamp from the bracket.

Note. The two straight pins in this assembly have their ends upset over. It may be necessary to drill out one end of each pin before they can be pressed out.

53. Disassembly of the Thumb Nut Assembly (fig. 28)

Chase the end of the eye bolt with the proper size thread chaser to remove the stake. Unscrew the thumb nut from the eyebolt.

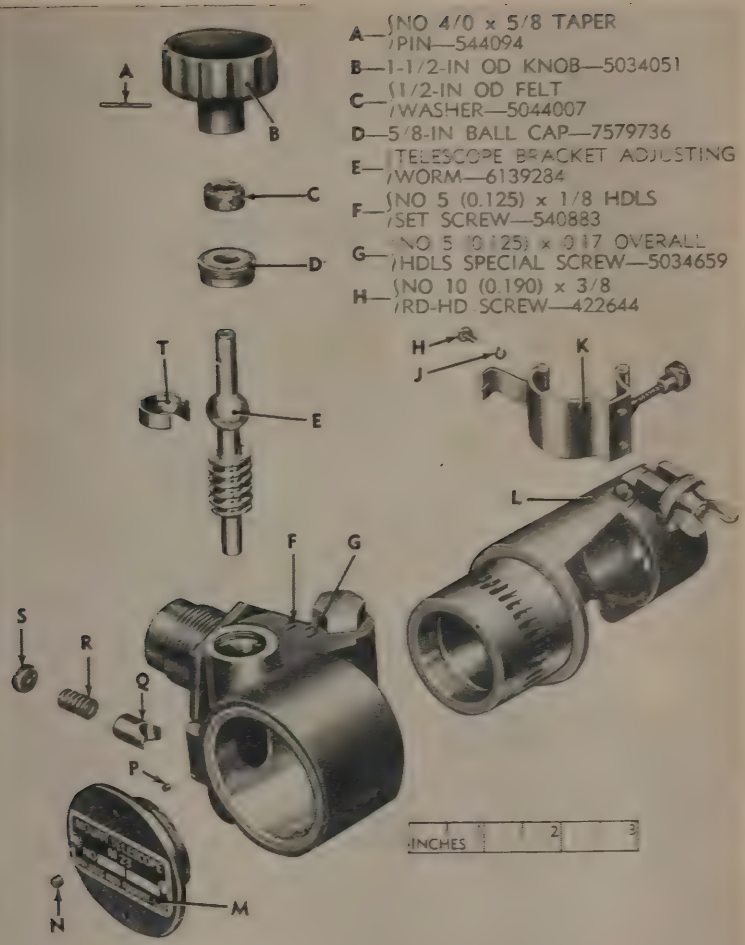

Figure 25. Telescope mount M23—removal of new assemblies and related parts—exploded view.

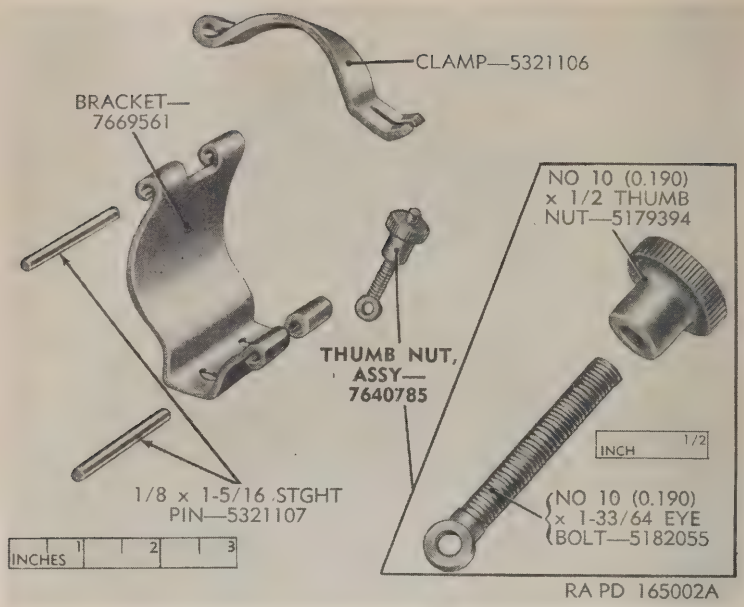

Figure 28. Telescope mount M23—instrument light clamp assembly—exploded view.

54. Disassembly of the Telescope Bracket Assembly

(fig. 29)

a. Straighten the two cotter pins in each end of the straight pin that secures the clamping bolt to the bracket assembly. Pull the cotter pin from each end of the straight pin, then press or drive out the straight pin. Remove the clamping bolt from the bracket.

b. Press or drive out the $\frac{1}{16}$ x $\frac{9}{16}$ straight pin that locks the 0.2497 x $1\frac{1}{4}$ straight pin in the bracket. Press or drive out the straight pin that secures the clamp to the bracket. Separate the clamp from the bracket.

55. Disassembly of the Housing Assembly

(fig. 30)

a. Remove the regular hex nut on the end of the hex-head cap screw that functions as a clamping screw for the housing support. Slide the lockwasher from the screw and extract the screw from the housing.

b. Support the collar on the end of the $2\frac{1}{8}$-inch long worm. Press or drive out the straight pin that secures the collar to the worm. Pull the collar from the worm. Unscrew the worm from the housing.

c. Remove the headless setscrew that locks the round nut on the threaded end of the housing support. Unscrew the round nut from the

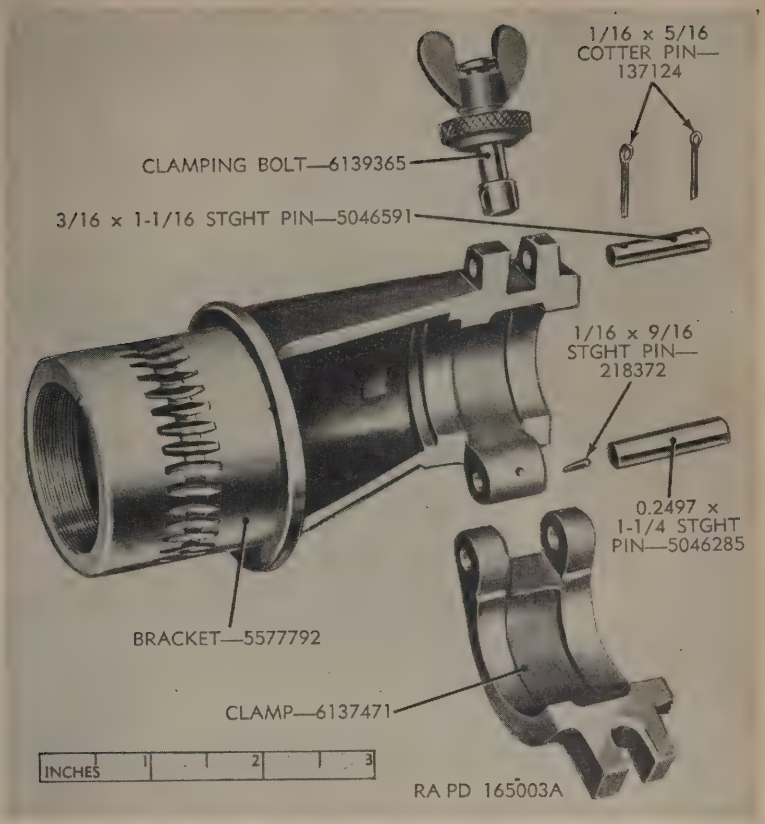

Figure 29. Telescope mount M23—telescope bracket assembly—exploded view.

housing support, with a spanner wrench. Pull the housing support from the housing.

56. Disassembly of the Housing

Press the oil cup from the housing. This is a preparatory step in permanently plugging up the oilcup hole (see pars. 26*c* and 57*b*).

57. Rebuild

a. General. All component parts having seating, locating, or bearing surfaces must be free of nicks, burs, or other deformities. On all threaded components, the threads must not be crossed or damaged. It is very important that, the in-process inspection be of the highest standards, since final acceptance of the assembled materiel depends largely upon the care exercised during the in-process inspection.

b. Oilcup. The oilcup on the housing must be permanently re-

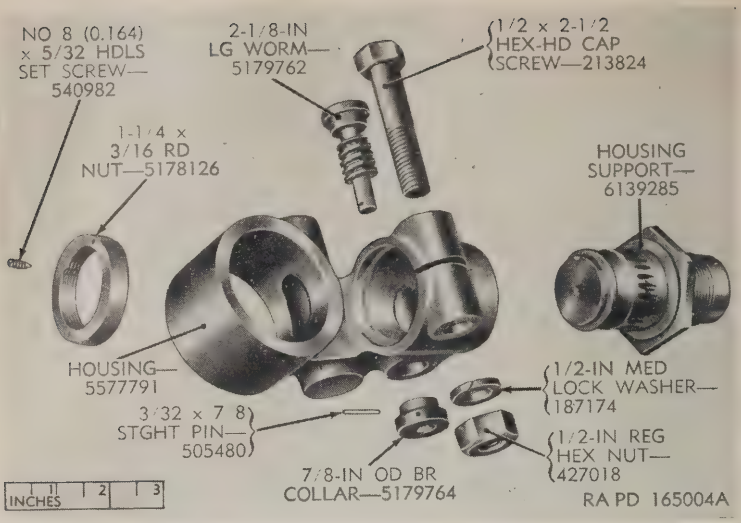

Figure 30. Telescope mount M23—housing assembly—exploded view.

moved. Using a $\frac{5}{16}$–18NC tap, tap out the hole. See paragraph 26*c* for detailed instructions.

c. Nameplate. The lettering on the nameplate must be clear and distinct.

d. Housing Support. The housing support shall be free of rust, burs, and corrosion. If any rust, burs, or corrosion is indicated, remove as directed in paragraph 24*c* and *d*. Clean the threaded parts of the support with the proper size thread chaser. Clean out the hobbed surface on the support and inspect for excessive wear or damage.

e. Housing. Inspect the housing for rust, burs, or corrosion; remove as directed in paragraph 24*c* and *d*. The bore of the housing must be round and have a smooth surface. The internal threaded surface for the ball cap must be cleaned with the proper size chaser.

f. Worms. Inspection and rebuild of worms can be found in paragraphs 34 through 36.

g. Ball Socket and Ball Cap. The ball socket and ball cap (metal-type only) must be lap-fitted to the worm ball. See paragraph 37 for proper procedure.

h. Worm Plunger. The worm plunger must be a lap-fit to the worm shaft. See paragraphs 38 and 39 for detailed instructions.

i. Telescope Bracket. Inspect the hobbed surface of the bracket for excessive damage or wear. Chase the internal threads on the bracket with the proper size thread chaser. Remove all burs, rust, or corrosion as directed in paragraph 24*c* and *d*.

j. Spring Specifications. The compression spring (fig. 27) must

meet the specifications listed in table IV for new coil springs. Replace the spring if it is corroded, set, weak, distorted, or fails to meet these standards (par. 45).

Table IV. Spring Standards

Spring	Part No.	Number of coils	Solid height (in.)	Load at solid height (lb)	Operating height (in.)	Load at operating height (lb)
Compression	5034447	8	0. 376	13. 5±1. 5	0. 406	12±1

k. Ceaning. Clean all components as in paragraph 25.

58. Assembly of the Housing

(fig. 30)

a. Lubricate (par. 26) the bore of the housing and the hobbed surface of the housing support. Insert the support in the housing. Screw the 1¼ x 3/16 round nut on the small threaded end of the support. With a spanner wrench, firmly tighten the round nut until the setscrew holes are alined. Screw in the No. 8 (0.164) x 5/32 headless setscrew and tighten securely. Test the movement of the support in the housing. It should be smooth and even, without any binding or up and down movement. It may be necessary to adjust the round nut on the support until the movement of the support is smooth and even, without looseness. If further adjustment is necessary, a new hole will have to be drilled for the setscrew. With a No. 29 drill, drill a hole half in the round nut and half in the housing support. Tap the hole with a No. 8–36NF–3 tap. The hole should be drilled 180 degrees from the original hole. If a new round nut or support is used, it will also be necessary to drill a hole in the round nut and support.

b. Inspect the thread on the 2⅛-inch worm. Lubricate (par. 26) the worm and insert in the housing. Rotate the worm with the fingers until the worm thread engages the gear teeth on the housing support. Press the ⅞-inch OD brass collar on the protruding end of the worm. Aline the pin holes in the collar with the pin hole in the worm. Support the collar and worm and press or drive in a 3/32 x ⅞ straight pin. Test the movement of the worm and support (par. 40).

c. Insert the ½ x 2½ hex-head cap screw in the housing. Place a ½-inch medium lockwasher on the end of the cap screw and screw on a regular hex nut. Tighten the nut against the washer, then back off at least one-half turn.

59. Assembly of the Telescope Bracket

(fig. 29)

a. Place the clamp in position on the bracket. Press or drive in the 0.2497 x 1¼ straight pin. Aline the hole in the pin with the hole in

the bracket, then press or drive in the $^1/_{16}$ x $^9/_{16}$ straight pin. This small straight pin functions as a lock for the larger straight pin.

b. Position the clamping bolt on the bracket and press in the $^3/_{16}$ x $1^1/_{16}$ straight pin. Install each of the two new $^1/_{16}$ x $^5/_{16}$ cotter pins, one at each end of the straight pin that secures clamping bolt in the bracket. Open the ends of the two cotter pins and bend back. Test the action of the clamping bolt. The straight pins function as hinges; be sure that pins perform their intended function.

60. Assembly of the Thumb Nut

(fig. 28)

Screw the No. 10 (0.190) x $^1/_2$ thumb nut on the No. 10 (0.190) x $1^{33}/_{64}$ eyebolt. Stake the last thread on the eyebolt to retain the thumb nut.

61. Assembly of the Instrument Light Clamp

(fig. 28)

a. Position the thumb nut assembly on the bracket and press or drive in a $^1/_8$ x $1^5/_{16}$ straight pin.

b. Position the clamp on the bracket and press or drive in the other $^1/_8$ x $1^5/_{16}$ straight pin. Spin-over both ends of the two straight pins. The straight pins function as hinges. Test their action.

62. Installation of Major Assemblies

(fig. 27)

a. Position the instrument light clamp assembly on the telescope bracket assembly (**L**) and secure in place with two No. 10 (0.190) x $^3/_8$ round-head screws and two medium lockwashers (**H** and **J**).

b. Lubricate (par. 26) the hob surface of the telescope bracket assembly (**L**) and the internal surfaces of the housing assembly. Press the telescope bracket assembly into the housing assembly, being careful not to damage the machined surfaces of the housing or bracket. Screw the telescope bracket plug into the telescope bracket assembly. With a spanner wrench, tighten the plug (**M**) until the setscrew hole in the plug aligns with the drill point in the telescope bracket assembly. Insert and tighten the No. 8 (0.164) x $^5/_{32}$ headless setscrew (**N**). Test the movement of the telescope bracket assembly in the housing by rotating with the fingers. The movement must be smooth and even without any binding, looseness, or up and down motion. It may be necessary to adjust the plug to obtain the desired movement. With the setscrew removed, rotate the telescope bracket assembly and, using the spanner wrench, tighten or loosen the plug until the movement of the telescope bracket is correct. When the correct movement is obtained, drill a hole with No. 29 drill, 180° from the original hole and on the centerline of the spanner wrench holes. Also, drill-point

the telescope bracket directly under the hole. Tap the hole in the plug with a No. 8–36NF–3 tap. Insert and tighten the setscrew. Check the movement of the telescope bracket assembly again. If a new plug is used, drill a hole 30° from a spanner wrench hole and on its centerline.

c. Lubricate (par. 26) the telescope bracket adjusting worm (E) and the 5/8-inch ball socket (T). Slide the ball socket on the worm between the worm ball and the worm teeth. Insert the worm in the housing, engaging the worm teeth with the gearing of the telescope bracket assembly. Rotate the telescope bracket assembly, to draw the worm all the way into the housing. Using a thin piece of wire, position the ball socket until the slot alines with the hole for the special screw. Screw in the No. 5 (0.125) x 0.17 overall headless special screw (G). Tighten the screw against the ball socket, then back off slightly. The special screw functions as a key for the ball socket and should not be tightened so as to force it off center.

d. Lubricate (par. 26) the 5/8-inch ball cap (D). Slide the cap on the worm and with a spanner wrench, screw it into the housing until it is tight, then back off slightly. Secure the ball cap with a No. 5 (0.125) x 1/8 headless setscrew (F). Tighten the screw securely.

e. Saturate the 1/2-inch OD felt washer (C) with oil and slide it on the worm (E) until it is positioned snugly against the ball cap. Slide the 1 1/2-inch OD knob (B) on the worm shaft. Support the knob and worm and press or drive in a No. 4/0 x 5/8 taper pin (A).

Note. See paragraphs 29 and 31 for detailed method for the installation of taper pins.

f. Lubricate (par. 26) the worm plunger (Q) and insert it into the housing, with the forked end over the worm shaft.

Note. The plunger must be a lap-fit. See paragraphs 38 and 39 for proper procedure.

g. Test the 0.325 OD x 21/32 compression spring (R) with the specifications in table IV. Lubricate (par. 26) the spring and insert it in the worm plunger (Q). Screw in brass plug (S) until it is snug. Insert and tighten the No. 5 (0.125) x 1/8 headless setscrew (P), to secure the plug. Rotate the worm by turning the knob; the worm should turn snugly but should not bind. To loosen or tighten movement of worm, loosen or tighten the ball cap.

63. Tests and Adjustments

a. Test of the Elevation Adjusting Worm Movement. With the use of a screwdriver, rotate the worm several turns. The movement should be smooth and even, without binding, clicking, or backlash. See paragraphs 34 through 44 for the more common malfunctions of worm-gear mechanisms and for tests and remedies.

b. Test of the Telescope Bracket Adjusting Worm Movement. Rotate the worm by turning the knob several turns. If worm binds, adjust the ball cap (par. 37). Test for backlash, clicking, chatter, etc. See paragraphs 34 through 44 for general maintenance.

c. Adjustment of the Round Nut. Adjustment of the round nut takes place at the time of assembly (par. 58*a*).

d. Adjustment of the Telescope Bracket Plug. Adjustment takes place at the time of assembly (par. 62*b*).

e. Adjustment of the Ball Cap. Adjustment takes place at the time of assembly (par. 62*d*).

Note. After all tests and adjustments have been completed, fill all screw heads with the proper sealing and plugging cement (see ORD 3 SNL K–1).

64. Installation to the On-Carriage Position

(fig. 26)

Position the mount, so that the housing support engages the threaded hole on the top of the range quadrant M4 or M4A1. Rotate the housing support, with the use of the proper size wrench, until the hex shoulder is securely tightened against the range quadrant bracket.

Section IV. TELESCOPE MOUNT M28

65. General

This section contains the procedure for removal, disassembly, rebuild, assembly, test and adjustment, and installation of telescope mount M28 (fig. 6).

66. Removal From the On-Carriage Position

Remove the six hex-head cap screws in the mounting bracket and pry the telescope mount from the on-carriage position. Remove the six lockwashers from the screws.

67. Removal of the Telescope Holder Assembly

(fig. 31)

a. Properly support the collar on the end of the worm and press or drive out the straight pin that secures the collar to the worm. Pry the collar from the worm. Unscrew the worm from the housing.

b. Unscrew the hex nut from the end of the hex-head cap screw and slide the lockwasher from the screw. Slide the hex-head cap screw from the telescope support housing.

c. Remove the headless setscrew that locks the plug assembly to the telescope holder assembly. With a spanner wrench, unscrew the plug assembly from the telescope holder assembly. Pull the telescope holder assembly from the telescope support housing.

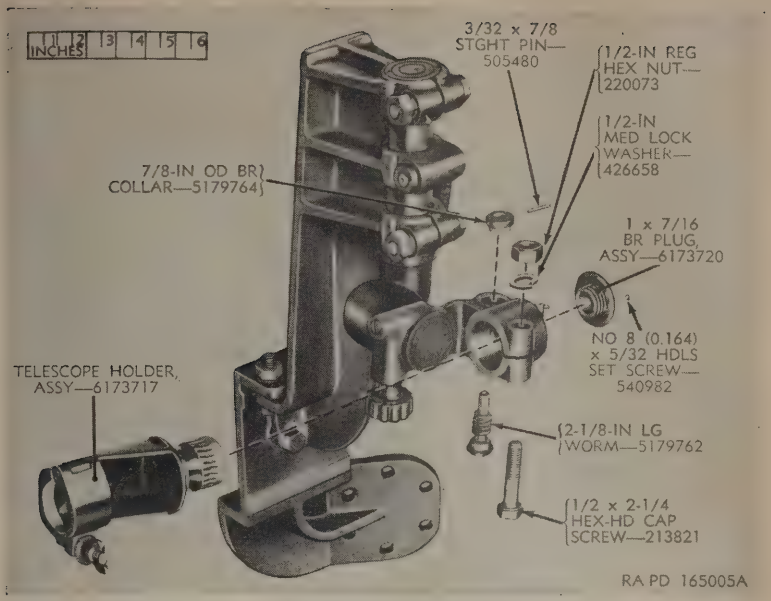

Figure 31. Telescope mount M28—Removal of the telescope holder assembly—exploded view.

68. Removal of the Telescope Support Housing (fig. 32)

a. Extract the headless setscrew (D) that locks the plug into position. Remove the plug (A) that retains the compression spring in the housing. Extract the compression spring and worm plunger (B and C) from the telescope support housing.

b. Properly support the knob (Q) and press or drive out the taper pin that secures the knob to the worm shaft. See paragraph 30 for proper method of removal of taper pins. Pull the knob and felt washer (N) from the worm shaft.

c. Remove the headless set screw (J) that locks the ball cap in the housing. With a spanner wrench, unscrew the ball cap (M) from the housing and slide the ball cap from the worm.

d. Remove the headless special screw (H) that locates the ball socket in the housing. Extract the elevation worm and ball socket (L and K) from the housing by rotating the housing until the worm clears the teeth of the spindle assembly. Slide the ball socket from the elevation worm.

e. Remove the headless set screw (F) that locks the round nut to the worm gear of the spindle assembly. With a spanner wrench, unscrew the round nut (G) from the worm gear. Slide the telescope

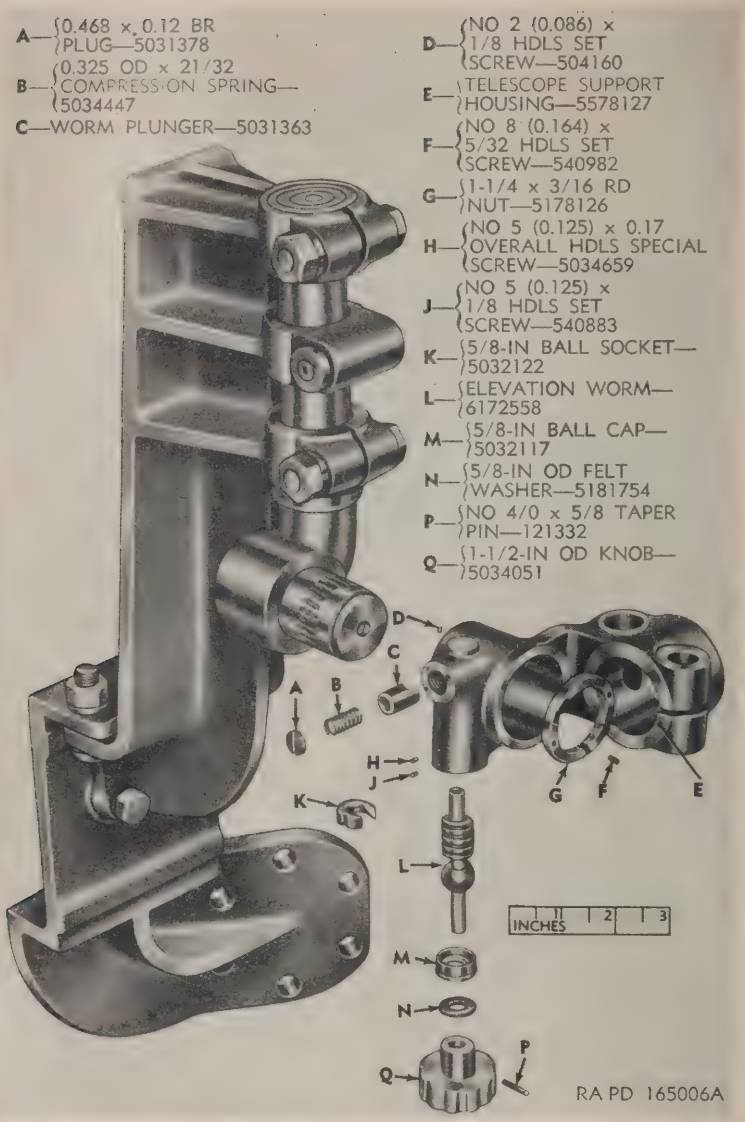

Figure 32. Telescope mount M28—removal of the telescope support housing—exploded view.

support housing (E) from the spindle assembly. Press the two oilcups from the telescope support housing; the oilcups will be permanently removed and the holes plugged. For the proper procedure, see paragraph 26*c*.

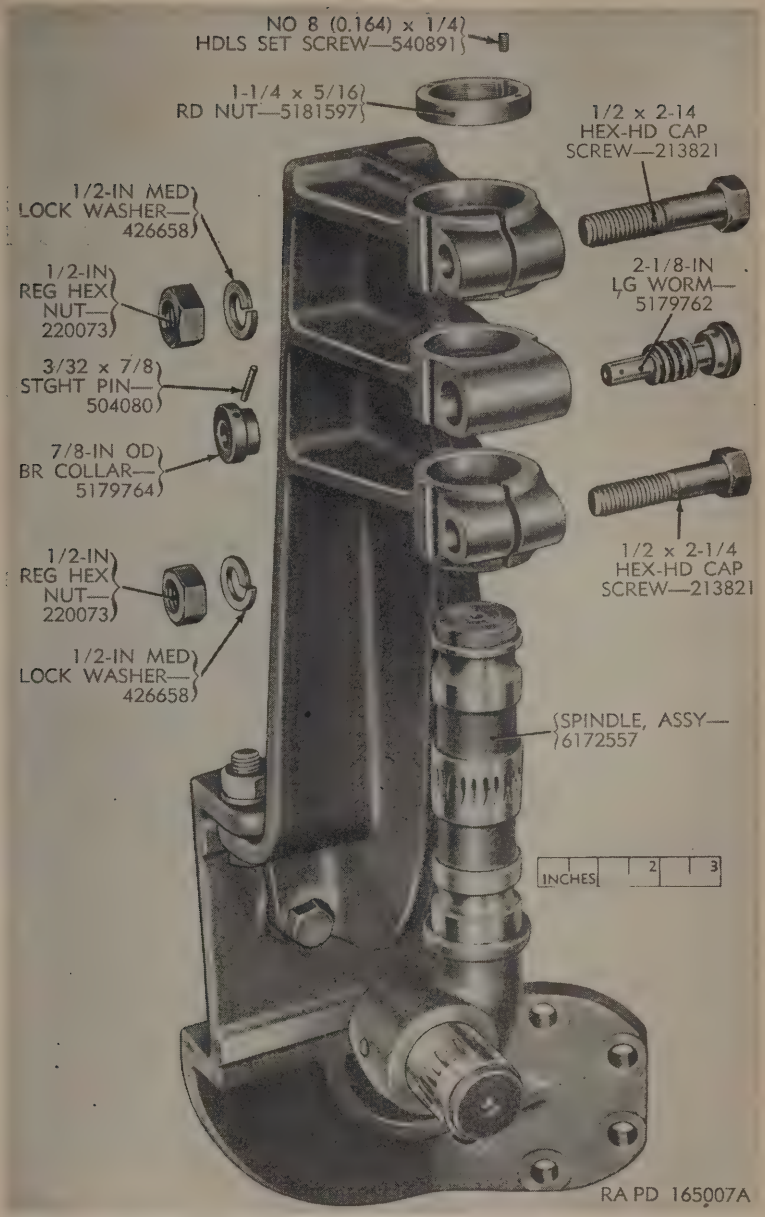

Figure 33. Telescope mount M28—removal of the spindle assembly—exploded view.

69. Removal of the Spindle Assembly
(fig. 33)

a. Properly support the collar on the end of the worm and press or drive out the straight pin that secures the collar to the worm. Pull the collar from the end of the worm. Unscrew the worm from the spindle assembly and extract it from the spindle bracket.

b. Remove the headless set screw that locks the round nut to the top of the spindle assembly. With a spanner wrench, unscrew the round nut from the spindle.

c. Unscrew the hex nut from the hex-head cap screw at the upper end of the spindle bracket. Slide the lock washer from the hex-head screw and extract the screw from the bracket. Unscrew the hex nut on the lower hex-head cap screw and slide the lock washer from the screw. Extract the cap screw from the spindle bracket.

d. Extract the spindle assembly from the spindle bracket.

Note. Use extreme care so as not to damage the bearing or sliding surfaces of the spindle.

70. Removal of the Instrument Light Clamp Assembly
(fig. 34)

Remove the four round-head screws and lock washers that secure the instrument light clamp assembly to the spindle bracket. Lift the instrument light clamp assembly from the bracket.

71. Removal of the Spindle Bracket From the Mounting Bracket
(fig. 34)

a. Remove the four hex nuts from the four hex-head cap screws that secure the two brackets together. Slide the lock washer from each of the four hex-head cap screws, and extract the four screws from the two brackets.

b. Separate the spindle bracket from the mounting bracket. Unscrew the grease fitting from the mounting bracket; the fitting will be removed permanently and the hole plugged (par. 26*c*).

72. Disassembly of the Telescope Holder Assembly
(fig. 35)

a. Straighten the cotter pin in each end of the straight pin that secures the clamping bolt to the holder. Pull the two cotter pins from the straight pin. Press or drive out the straight pin and separate the clamping bolt from the holder.

b. Press or drive out the straight pin that locks the 0.2497 x 1¼ pin (hinge) in the holder. Press or drive out the hinge pin and separate the clamp from the holder.

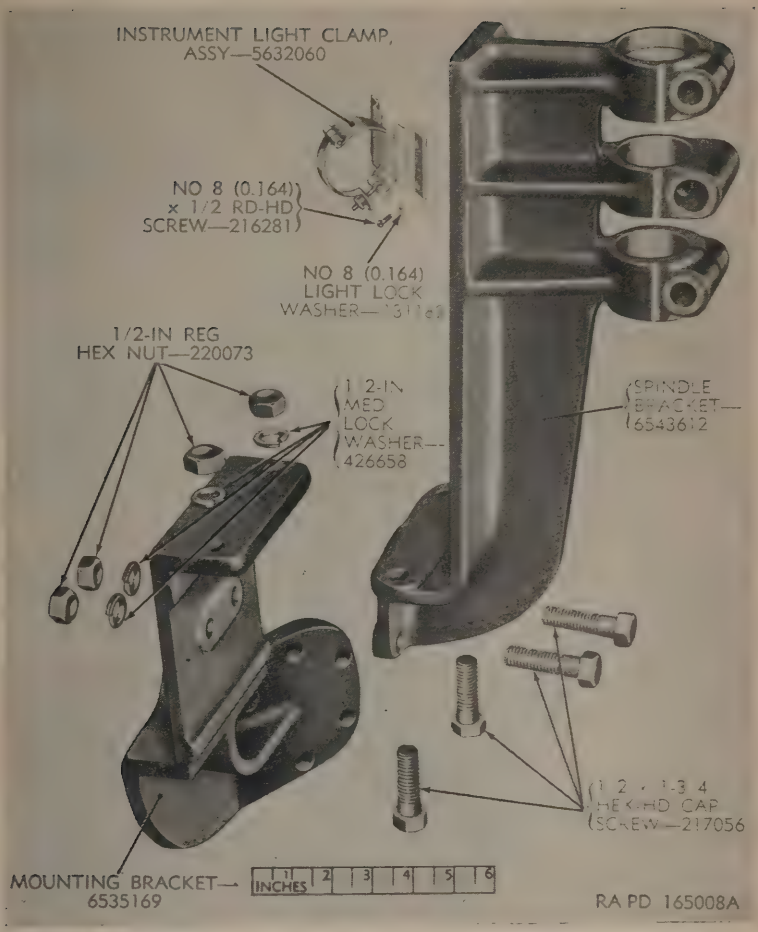

Figure 34. Telescope mount M28—removal of the spindle bracket from the mounting bracket—exploded view.

73. Disassembly of the Plug Assembly

(fig. 36)

Note. Do not disassemble the plug assembly unless the nameplate or plug has been damaged.

With a sharp chisel, cut off the heads of the two rivets that secure the nameplate to the plug. Lift the nameplate from the plug. Press out the parts of the rivets that remain in the plug.

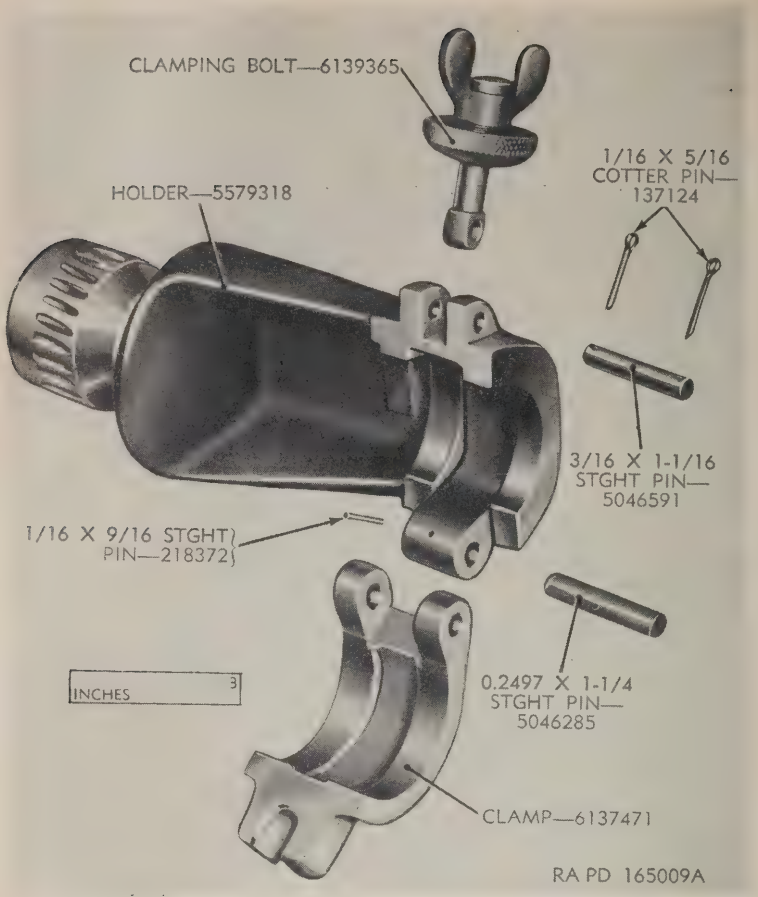

Figure 35. Telescope mount M28—telescope holder assembly—exploded view.

74. Disassembly of the Instrument Light Clamp Assembly (fig. 37)

a. Press or drive out the straight pin that secures the clamp to the bracket. Separate the clamp from the bracket.

b. Press or drive out the straight pin that secures the thumb nut assembly to the bracket. Separate the thumb nut assembly from the bracket.

Note. The two straight pins in this assembly have their ends spun-over; therefore, it may be necessary to drill one end of the pin before attempting to drive it out.

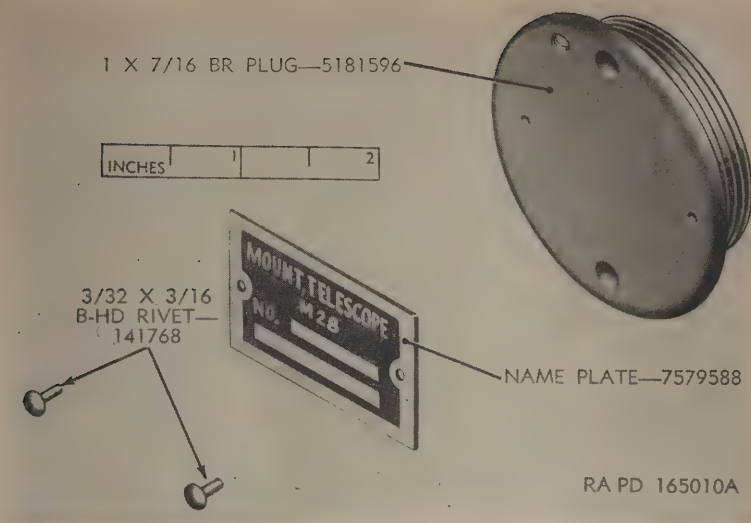

Figure 36. Telescope mount M28—plug assembly—exploded view.

75. Disassembly of the Thumb Nut Assembly

For disassembly of the thumb nut assembly (fig. 37), which is identical to the thumb nut assembly on the telescope mount M23 (fig. 28), see paragraph 53.

76. Disassembly of the Spindle Assembly (fig. 38)

a. Properly support the spindle assembly with the small end of the taper pin accessible. Press or drive out the taper pin that secures the worm gear in the spindle. (See paragraph 30 for proper method of removing taper pins.)

b. Press the worm gear from the spindle.

77. Rebuild

a. General. All component parts having seating, locating, or bearing surfaces must be free of nicks, burs, or other deformities. On all threaded components, the threads must not be crossed or damaged. It is very important that the in-process inspection be of the highest standards, since final acceptance of the assembled materiel depends largely upon the care exercised during the in-process inspection.

b. Oilcups and Grease Fitting. The oilcups on the housing support and the grease fitting on the mounting bracket will be permanently removed and the holes plugged (par. 26*c*).

c. Nameplate. All lettering must be clear and distinct.

d. Telescope Support Housing. The internal bearing surfaces of

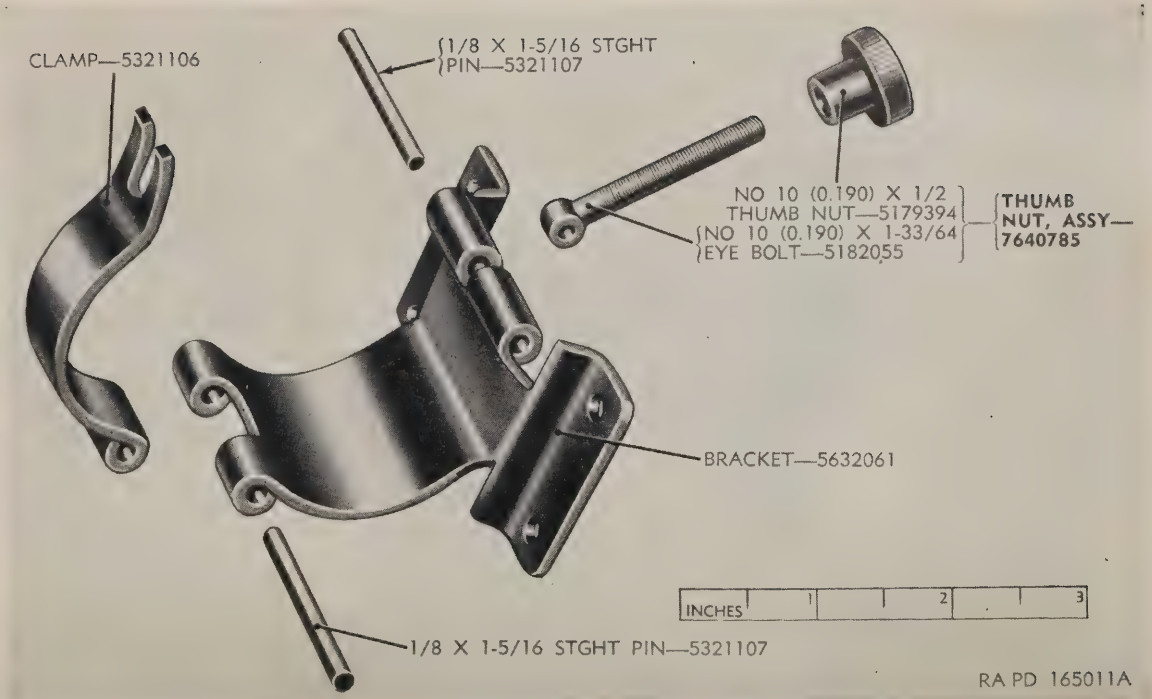

Figure 37. Telescope mount M28—instrument light clamp assembly—exploded view.

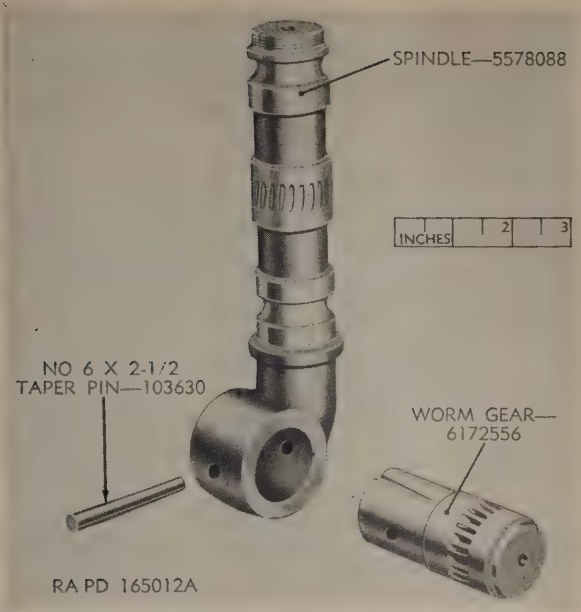

Figure 38. Telescope mount M28—spindle assembly—exploded view.

the housing must be smooth and free of nicks or burs. If nicks or burs are present, remove as directed in paragraph 24*c* and *d*. Chase the threaded sections of the housing with the proper size thread chaser.

e. Worms. Rebuild the worms as directed in paragraphs 35 and 36. If either worm has been worn to a knife edge, it must be replaced.

f. Mounting Bracket. The surfaces of the bracket must be free of nicks, burs, and any other foreign matter. Remove nicks, burs, and other foreign matter as directed in paragraph 24*c* and *d*.

g. Spindle Bracket. The bearing surfaces for the spindle must be smooth and free of nicks and burs. Remove all nicks, burs, and other foreign matter as directed in paragraph 24*c* and *d*.

h. Telescope Holder. Clean the hobbed surface of the holder, so as to afford a good contact for the worm. Inspect the hob for excessive wear or damage. Clean the inside of the holder with fine emery cloth, to remove any rust.

i. Ball Cap Socket. Lap the ball cap and socket to the worm ball as directed in paragraph 37.

j. Spindle. Inspect the spindle for nicks, burs, or other foreign matter. Remove nicks, burs, corrosion, or rust as directed in paragraph 24*c* and *d*. Chase the thread on the top of the spindle with the proper size thread chaser. Clean the hole at the end of the spindle.

k. Springs. The spring used in the telescope mount M28 is identical

to the spring on the telescope mount M23; see table IV for specifications.

l. Cleaning. Clean all components as directed in paragraph 25.

m. Plungers. The worm plunger must be a lap-fit to the worm shaft (pars. 38 and 39).

78. Assembly of the Spindle

(fig. 38)

a. Lubricate (par. 26) the worm gear and press it into the spindle, alining the taper pin holes. Press or drive in the No. 6-0 x 2½ taper pin to secure the gear in the spindle. See paragraphs 27, 28, 29, and 31 for methods of installing taper pins.

b. If a new gear is used, the hole for the taper pin will have to be drilled. With the gear positioned in the spindle, center-punch the gear through the small taper pin hole in the spindle. Drill and ream a hole to take a No. 6-0 x 2½ taper pin. See paragraph 27 for proper size of drills and reamers.

79. Assembly of the Thumb Nut

For assembly of the thumb nut assembly (fig. 37), which is identical to the thumb nut assembly on the telescope mount M23 (fig. 28), see paragraph 60.

80. Assembly of the Instrument Light Clamp

(fig. 37)

a. Position the thumb nut assembly on the bracket and press or drive in the $\frac{1}{8}$ x $1\frac{5}{16}$ straight pin.

b. Position the clamp on the bracket and press or drive in the $\frac{1}{8}$ x $1\frac{5}{16}$ straight pin. Spin-over the ends of the two straight pins. These straight pins function as hinges in this assembly; be sure they perform their intended function properly.

81. Assembly of the Plug

(fig. 36)

Position the nameplate on the 1 x $\frac{7}{16}$ brass plug. Rivet the nameplate to the plug with two $\frac{3}{32}$ x $\frac{3}{16}$ button-head rivets. Finish the bucked end of the rivets smooth with the plug. Check to see that the nameplate is not loose on the plug.

82. Assembly of the Telescope Holder

(fig. 35)

a. Position the clamp on the holder and press or drive in the 0.2497 x $1\frac{1}{4}$ straight pin that functions as a hinge. Aline the drill hole in the hinge pin with the hole in the holder. Press or drive in the $\frac{1}{16}$ x $\frac{9}{16}$ straight pin that functions as a lock for the hinge pin. Rivet-over the ends of the lock pin.

b. Place the clamping bolt in position on the holder and press or drive in the $^3/_{16}$ x $1^1/_{16}$ straight pin that functions as a hinge for the clamping bolt. Replace the two $^1/_{16}$ x $^5/_{16}$ cotter pins and insert one in each end of the hinge pin. Separate the ends of the cotter pins and bend over. Inspect the action of the bolt and clamp; be sure the hinge pins perform their function properly.

83. Installation of the Spindle Bracket on the Mounting Bracket (fig. 34)

a. Position the spindle bracket on the mounting bracket and insert the four ½ x 1¾ hex-head cap screws in the two brackets.

b. Slide a ½-inch medium lock washer on each of the four hex-head cap screws. Screw a regular hex nut on each of the cap screws and tighten securely.

84. Installation of the Instrument Light Clamp Assembly (fig. 34)

Position the instrument light clamp assembly on the spindle bracket and secure in position with four No. 8 (0.164) x ½ round-head screws and four light lock washers. Tighten the screws securely.

85. Installation of the Spindle Assembly (fig. 33)

a. Lubricate (par. 26) the spindle assembly and slide it up into the spindle bracket.

Note. Use care so as not to damage the bearing surface of the spindle and/or spindle bracket.

b. Screw the $1^1/_4$ x $^5/_{16}$ round nut on the top of the spindle. Tighten the round nut securely with a spanner wrench until the set screw holes aline. Insert and tighten the No. 8 (0.164) x ¼ headless set screw and tighten securely. Check the action of the spindle. The movement should be smooth and even without any binding or endplay. The round nut may have to be adjusted to remove any endplay or binding. Remove the set screw and, while rotating the spindle, tighten or loosen the round nut until the spindle functions correctly. If the set screw holes in the round nut and spindle do not aline, a new hole must be drilled, half in the round nut and half in the spindle. Drill this hole ¼-inch deep with a No. 29 drill. Tap the hole with a No. 8–36NF–3 tap. Screw in the set screw and tighten. Test the movement of the spindle.

c. Insert the two ½ x $2^1/_4$ hex-head cap screws (clamping screws) in the spindle bracket. These screws go in the two outside holes on the bracket. Slide a ½-inch medium lock washer on each of the two clamping screws. Screw a regular hex nut on the two ½ x $2^1/_4$ screws (clamping). Tighten the hex nuts securely.

d. Lubricate (par. 26) the 2⅛-inch long worm and screw it into the middle hole on the spindle bracket. Press the ⅞-inch OD brass collar on the protruding end of the worm, alining the holes in the collar with the hole in the worm. Press or drive in a $^{3}/_{32}$ x ⅞ straight pin to secure collar. Loosen the two ½ x 2¼ screws (clamping) and, with a screwdriver, rotate the worm. The movement of the worm and spindle should be smooth and even, without any binding or endplay.

86. Installation of the Telescope Support Housing (fig. 32)

a. Lubricate (par. 26) the inside surfaces of the telescope support housing (E) and the bearing surface of the worm gear on the spindle assembly.

b. Slide the housing on the worm gear.

Note. Be careful not to damage the machined surfaces.

c. Screw the 1¼ x $^{3}/_{16}$ round nut (G) on the protruding end of the worm gear. With the proper size spanner wrench, tighten the round nut securely until the set screw holes in the round nut and worm gear aline. Screw the No. 8 (0.164) x $^{5}/_{32}$ headless set screw (F) into the round nut and worm gear. Tighten the set screw securely. Rotate the housing by hand. The movement should be smooth and even without any binding or endplay. If any binding or endplay is indicated, the round nut must be adjusted to correct it. Remove the set screw. Using a spanner wrench, tighten or loosen the round nut while rotating the housing. When the housing movement is free of binding or endplay, no further adjustment of the round nut is necessary. If movement of the round nut disturbs the alinement of the set screw holes, a new hole must be drilled. With a No. 29 drill, drill a hole half in the round nut and half in the worm gear, 180° from the original hole in the round nut. Tap the hole with a No. 8–36NF–3 tap. Insert and tighten the set screw. Test the action of the housing.

d. Lubricate (par. 26) the ⅝-inch ball socket (K) and elevation worm (L). Slide the ball socket on the worm between the worm thread and worm ball. Insert the elevation worm into the telescope support housing. Rotate the worm with the fingers until the worm is seated properly.

e. With a thin piece of wire, position the slot in the ball socket directly under the hole for the special screw. Screw the No. 5 (0.125) x 0.17 overall headless special screw (H) into the housing, engaging the dog-point of the screw in the slot of the ball socket. Tighten the screw securely, then back off slightly.

Note. The special screw functions as a key for the ball socket. It should not force the ball socket off center (par. 42).

f. Lubricate (par. 26) and slide the ⅝-inch ball cap (M) on the end of worm. With a spanner wrench, screw the ball cap tightly into the housing. Back off on the ball cap slightly. Screw the No. 5

(0.125) x 1/8 headless set screw (J) into the housing to lock the ball cap.

g. Lap the worm plunger (pars. 38 and 39) to the worm shaft. Test the 0.325 OD x 21/32 compression spring with the specifications in table IV. Insert the worm plunger (C) in the housing, with the forked end over the worm shaft. Insert the compression spring (B) into the worm plunger. Screw the 0.468 x 0.12 brass plug (A) into the housing, to retain the spring. Insert the No. 2 (0.086) x 1/8 headless set screw (D), to lock the plug. Tighten all the set screws securely, except the special screw.

h. Saturate the 5/8-inch OD felt washer (N) with oil. Slide the felt washer on the worm shaft. Slide the 1½-inch OD knob (Q) on the worm shaft, alining the taper pin holes. Press or drive in the No. 4/0 x 5/8 taper pin (P), to secure the knob to the worm.

87. Installation of the Telescope Holder Assembly (fig. 31)

a. Lubricate (par. 26) the telescope holder hobbed surface. Insert the telescope holder assembly in the telescope support housing. With a spanner wrench, screw the 1 x 7/16 brass plug assembly into the telescope holder assembly. Tighten the plug assembly until the set screw hole in the plug alines with the drill point in the telescope holder. Screw the No. 8 (0.164) x 5/32 headless set screw in the plug assembly until it is tight against the telescope holder. Rotate the telescope holder assembly; the movement should be smooth and even, without binding or endplay. If there is any endplay or binding present, the plug assembly must be adjusted. Remove the set screw. While rotating the telescope holder assembly, tighten or loosen the plug assembly until all binding or endplay is removed. If the set screw holes do not aline, drill a new hole 180° from the original hole with a No. 29 drill. Let the drill drill-point the telescope holder. Tap the hole with a No. 8–36NF–3 tap. Insert and tighten the set screw. Check the movement of the telescope holder assembly.

b. Insert the ½ x 2¼ hex-head cap screw in the clamping device on the telescope support housing, from the underside of the housing into the housing. Slide a ½-inch medium lock washer on the cap screw. Screw a ½-inch regular hex nut on the cap screw. Tighten the nut securely.

c. Lubricate (par. 26) the 2⅛-inch long worm. Screw the worm into the housing, engaging the hob on the telescope holder. The worm must also enter the housing from the under side. Press the 7/8-inch OD brass collar on the protruding end of the worm. Aline the pin holes in the collar and worm. Press or drive in the 3/32 x 7/8 straight pin. Plug all used and unused screw holes with the proper sealing and plugging cement (ORD 3 SNL K–1).

88. Tests and Adjustments

a. Adjustment of the Plug Assembly. See paragraph 87*a*.

b. Adjustment of the Telescope Support Housing Round Nut. See paragraph 86*c*.

c. Adjustment of Spindle Assembly Round Nut. See paragraph 85*b*.

d. Adjustment of the Ball Cap and Ball Socket. See paragraph 37.

e. Test of Spindle Assembly Movement. Loosen the hex nuts (fig. 33) on the two hex-head cap screws that clamp the spindle assembly in the spindle bracket. Using a screwdriver, rotate the worm in the spindle bracket a few turns. The movement should be smooth and even, without any binding or endplay. Any binding or endplay that is present must be removed by adjusting the round nut on the spindle (par. 86). Tighten the clamping screw nuts and attempt to rotate the worm. There should not be any movement of the spindle.

f. Test of the Telescope Holder Assembly Worm Movement. Test this worm movement as in *e* above.

g. Test of the Elevation Worm Movement. Rotate the worm knob a few turns. The movement should be smooth and even without binding.

h. Test for Backlash. See paragraphs 19 and 41.

i. Test for Chatter, Clicking, Undue Looseness, etc., in the Worm Mechanisms. If any of these malfunctions are present, see paragraphs 34 through 44 on general maintenance.

89. Installation to the On-Carriage Position

Slide a ½-inch medium lock washer on each of the six ½ x 1¼ hex-head cap screws. Press the telescope mount in position on the weapon. Insert the six screws in the mounting bracket and tighten them securely into the weapon.

Section V. TELESCOPE MOUNT M31

90. General

This section contains the procedure for removal, disassembly, rebuild, assembly, test and adjustment, and installation of the telescope mount M31 (fig. 7).

91. Removal From the On-Carriage Position

Remove the six hex-head cap screws and lock washers that secure the telescope to the on-carriage position. Work the mount from the trunnion extension and the straight pin.

92. Removal of the Telescope Holder Assembly (fig. 39)

a. Support the collar on the end of the worm and press or drive out the straight pin that secures the collar to the worm. Pull the collar

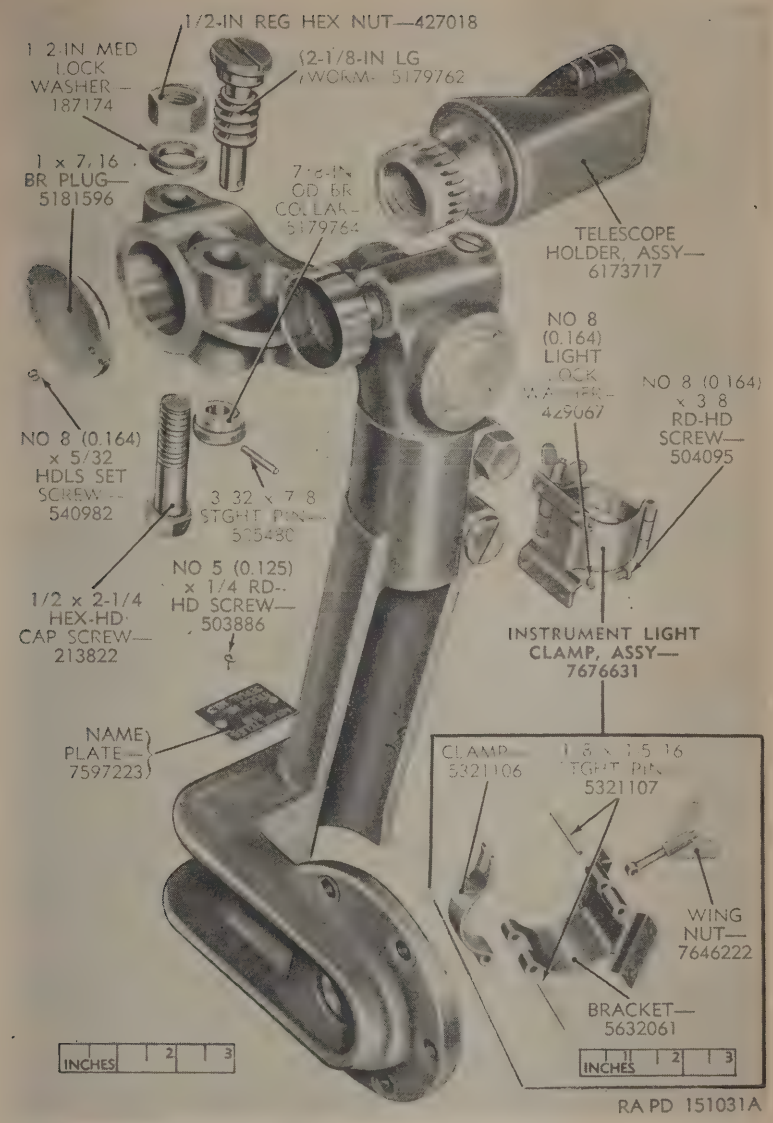

Figure 39. Telescope mount M31—removal of the major assemblies—exploded view.

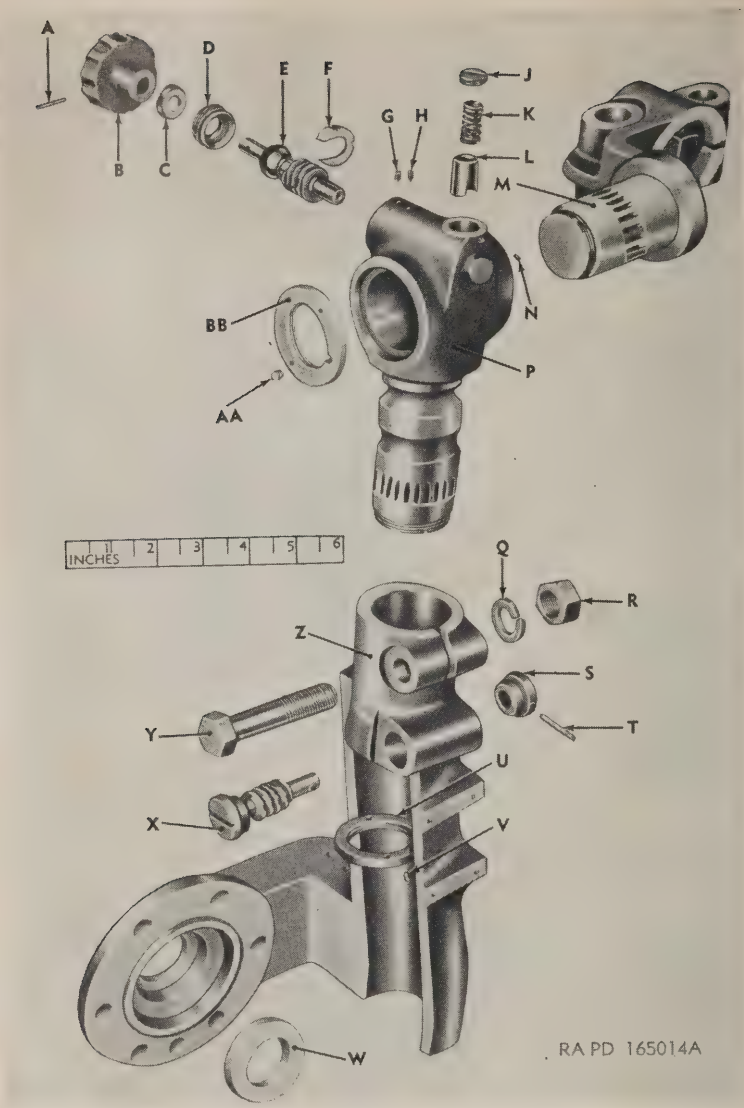

Figure 40. Telescope mount M31—components partially exploded.

from the worm. Unscrew the worm from the telescope holder support and telescope holder assembly.

b. Remove the headless set screw that locks the plug in the telescope holder. With a spanner wrench, unscrew the plug from the telescope holder assembly.

c. Remove the hex nut on the hex-head cap screw (clamping screw). Slide the lock washer from the hex-head cap screw. Extract the cap screw from the telescope holder support, and remove the telescope holder assembly.

93. Removal of the Instrument Light Clamp Assembly (fig. 39)

Remove the four round-head screws and lock washers that secure the clamp assembly to the telescope support housing bracket. Lift the instrument light clamp assembly from the bracket.

94. Removal of the Nameplate (fig. 39)

Remove the two round-head screws that secure the nameplate to the telescope support housing bracket. Lift the nameplate from the bracket.

A—No. 4/0 x 5/8 taper pin—544094
B—1½-in od knob—7595287
C—5/8-in od felt washer—5181754
D—5/8-in ball cap—7579736
E—Elevation worm—6172558
F—5/8-in ball socket—7579739
G—No. 5 (0.125) x 1/8 hdls set screw—540883
H—No. 5 (0.125) x 0.17 overall hdls special screw—5034659
J—0.468 x 0.12 br plug—5031378
K—0.325 x 21/32 compression spring—5034447
L—Worm plunger—5031363
M—Telescope holder support—7673961
N—No. 2 (0.086) x 1/8 hdls set screw—504160
P—Telescope holder support housing—7673962
Q—½-in med lock washer—187174
R—½-in reg hex nut—427018
S—7/8-in od br collar—5179764
T—3/32 x 7/8 stght pin—505480
U—1¼ x 3/16 rd nut—5178126
V—No. 8 (0.164) x 5/32 hdls set screw—540982
W—Oil seal—5223785
X—2⅛-in lg worm—5179762
Y—½ x 2¼ hex-hd cap screw—213822
Z—Telescope support housing bracket—7647791
AA—No. 8 (0.164) x 5/32 hdls set screw—540982
BB—1¼ x 3/16 rd nut—5178126

Figure 40—Continued.

95. Removal of the Telescope Holder Support

(fig. 40)

a. Support the knob (B) and press or drive out the taper pin that secures the knob to the elevation worm. Pull the knob and felt washer (C) from the worm.

b. Remove the headless set screw (N) that locks the plug (spring retaining) in the telescope holder support housing. Unscrew the brass plug (J). Extract the compression spring and worm plunger (K and L) from the housing.

c. Remove the headless set screw (G) that locks the ball cap in the housing. With a spanner wrench, unscrew the ball cap (D) from the housing. Slide the ball cap from the worm shaft.

d. Loosen the headless special screw (H) that locates the ball socket in the housing. Extract the elevation worm and ball socket (E and F) by rotating the telescope holder support. Slide the ball socket from the elevation worm.

e. Remove the headless set screw (AA) that locks the round nut on the end of the telescope holder support. While holding the support securely, unscrew the round nut (BB) from the telescope support with a spanner wrench. Slide the telescope holder support (M) from the telescope holder support housing (P).

Note. Use care so as not to damage the bearing surfaces of the support and housing.

96. Disassembly of the Telescope Holder Support Housing and Bracket

(fig. 40)

a. Support the collar (S) on the end of the worm in the telescope support housing bracket (Z). Press or drive out the straight pin (T) that secures the collar to worm. Pull the collar from the worm. Unscrew the worm (X) from the bracket.

b. Remove the headless set screw (V) that locks the round nut on the end of the telescope holder support housing. With a spanner wrench, unscrew the round nut (U) from the end of the housing.

c. Remove the hex nut (R) on the end of the hex-head cap screw that clamps the telescope holder support housing in the telescope support housing bracket. Slide the lock washer (Q) from the hex-head cap screw. Extract the cap screw from the bracket. Extract the telescope holder support housing.

Note. Use care so as not to damage the bearing surface of the housing and bracket.

d. If the oil seal (W) requires replacement, press out the seal. Do not remove the seal from the bracket unless necessary.

97. Disassembly of the Telescope Holder Assembly (fig. 39)

For disassembly of the telescope holder assembly, which is identical to the telescope holder assembly on the telescope mount M28, see paragraph 72.

98. Disassembly of the Instrument Light Clamp Assembly (fig. 39)

a. Press or drive out the straight pin that secures the clamp to the bracket. Separate the clamp from the bracket.

b. Press or drive out the straight pin that secures the wing nut to the bracket. Separate the wing nut from the bracket.

Note: The two straight pins in this assembly have their ends spun-over; therefore, it may be necessary to drill one end of the pin before attempting to drive it out.

99. Rebuild

a. General. All component parts having seating, locating, or bearing surfaces must be free of nicks, burs, or other deformities. On all threaded components, the threads must not be crossed or damaged. It is very important that the in-process inspection be of the highest standards, since final acceptance of the assembled materiel depends largely upon the care exercised during the in-process inspection.

b. Worms. Rebuild the worms as directed in paragraphs 35 and 36.

c. Telescope Holder. Clean all rust and corrosion (par. 24*d*) from the inside of the holder. Remove all burs or nicks (par. 24*c*) from the bearing and hobbed surfaces of the holder.

d. Telescope Holder Support. Remove the oil cup in the support as directed in paragraph 26*c*. Remove all nicks or burs (par. 24*c*) from the bearing surfaces. Remove all rust or corrosion (par. 24*d*). Clean the hobbed surface and inspect for excessive wear. Chase the threaded surface with the proper size thread chaser.

e. Telescope Holder Support Housing. Remove the two oil cups as directed in paragraph 26*c*. Remove all rust, corrosion (par. 24*d*), nicks, or burs (par. 24*c*). The internal bearing surface for the support must have a smooth finish. Clean the hobbed surface and inspect for excessive wear. Chase the threaded surfaces with the proper size thread chaser.

f. Telescope Support Housing Bracket. Remove all rust or corrosion (par. 24*d*). Remove all nicks or burs (par. 24*c*). The internal bearing surface for the housing must be free of nicks and burs and have a smooth finish.

g. Ball Cap and Socket. The ball cap and socket must be lapped to the elevation worm ball. See method in paragraph 37.

h. Instrument Light Clamp Assembly. Any nicks or bends in the components of this assembly may be hammered out.

i. Cleaning. Clean all components of the mount as directed in paragraph 25.

j. Nameplates. The nameplate must be straight. The lettering must be clear and distinct.

k. Worm Plunger. Rebuild the worm plunger as directed in paragraphs 38 and 39.

l. Spring. The spring in telescope mount M31 is identical to the spring on the telescope mount M23. See table IV for specifications.

100. Assembly of the Instrument Light Clamp
(fig. 39)

a. Position the wing nut on the bracket and press or drive in the $\frac{1}{8}$ x $1\frac{5}{16}$ straight pin.

b. Position the clamp on the bracket and press or drive in the $\frac{1}{8}$ x $1\frac{5}{16}$ straight pin. Spin-over the ends of the two straight pins. These pins function as hinges in this assembly; be sure they perform their intended function properly.

101. Assembly of the Telescope Holder
(fig. 39).

For assembly of the telescope holder assembly, which is identical to the telescope holder assembly on the telescope mount M28, see paragraph 82.

102. Installation of the Telescope Holder Support Housing
(fig. 40)

a. Lubricate (par. 26) the hobbed surface and bearing surface of the telescope holder support housing (P) and the internal bearing surface of the telescope support housing bracket. Slide the telescope holder support housing down into the telescope support housing bracket (Z).

Note. Use care so as not to damage the bearing surfaces of the housing or bracket.

b. Screw the $1\frac{1}{4}$ x $\frac{3}{16}$ round nut (U) on the end of the housing. Using a spanner wrench, tighten the round nut until the set screw holes aline. Rotate the housing with fingers. The movement should be smooth and even without any binding or endplay. If any binding or endplay is indicated, the round nut must be adjusted to correct it. While rotating the housing, loosen or tighten the round nut with the spanner wrench until the desired movement is obtained. If the set screw holes are now disalined, a new hole will have to be drilled and tapped. Drill the hole with a No. 29 drill 180° from the original hole. The hole must be half in the round nut and half in the housing. The hole must be deep enough to take a No. 8 (0.164) x $\frac{5}{32}$ screw. Tap the hole with a No. 8–36NF–3 tap. Insert the No. 8 (0.164) x

5/32 headless set screw (V) in the hole and tighten securely. Test the movement of the housing. Stake the screw in place.

c. Insert the 1/2 x 2 1/4 hex-head cap screw (Y) in the top hole in the bracket. Slide a 1/2-inch medium lock washer (Q) on the hex-head cap screw. Screw a 1/2-inch regular hex nut (R) on the cap screw and tighten securely.

d. Lubricate (par. 26) the 2 1/8-inch long worm and screw the worm (X) into the bracket. Press the 7/8-inch OD brass collar (S) on the protruding end of the worm. Aline the straight pin holes in the collar and worm. Press or drive in a 3/32 x 7/8 straight pin (T) to secure the collar to the worm. Be sure the collar is well supported before driving in the straight pin.

e. With a screwdriver, and with the clamping screw loose, rotate the worm several turns. The movement should be smooth and even. It may be necessary to lap the worm to the hob of the housing (par. 40).

f. Press a new oil seal into the bracket (fig. 40), if replacement is necessary.

103. Installation of the Telescope Holder Support (fig. 40)

a. Lubricate (par. 26) the hob and bearing surfaces of the telescope holder support. Insert the support (M) in the telescope holder support housing.

Note. Be careful not to damage the bearing surfaces.

With a spanner wrench, screw the 1 1/4 x 3/16 round nut (BB) on the support; tighten the round nut securely. Test the movement of the support. If necessary, adjust the round nut as in paragraph 102*b*. Screw the No. 8 (0.164) x 5/32 headless set screw (AA) in the round nut and support. Stake the set screw in place.

b. Lubricate (par. 26) the elevation worm and 5/8-inch ball socket. Slide the ball socket (F) on the worm between the worm ball and worm thread. Insert the elevation worm and ball socket into the telescope holder support housing, engaging the worm thread in the hob of the telescope holder support. Using a thin piece of wire, position the slot in the ball socket under the hole for the special screw (H) in the housing. Screw the No. 5 (0.125) x 0.17 overall headless special screw (H) into the housing, being sure the dog point enters the slot in the ball socket. Tighten the special screw, then back off slightly. The special screw functions as a key for the socket; therefore, it should not be tightened so as to force the ball socket off center.

c. Lubricate (par. 26) the 5/8-inch ball cap (D) and slide over the worm shaft. Screw the ball cap (D) into the housing. With the use of a spanner wrench, tighten the ball cap until it is tight against the worm ball, then back off slightly. Screw the No. 5 (0.125) x 1/8 headless set screw (G) into the housing, to lock the ball cap and stake into place. Slide the 5/8-inch OD felt washer (C) on the worm shaft.

d. Lap the worm plunger (L) to the worm shaft (pars. 38 and 39). Test the 0.325 OD x $^{21}/_{32}$ compression spring against the specifications in table IV. Lubricate (par. 26) and insert the worm plunger (L) in the housing, with the forked end over the worm shaft. Lubricate (par. 26) the compression spring (K) and insert the spring in the plunger. Screw the 0.468 x 0.12 brass plug (J) into the housing. Rotate the elevation worm as the plug is tightened. When the worm has a smooth even movement, no further adjustment of the plug is necessary. Screw the No. 2 (0.086) x $^1/_8$ headless set screw (N) in the housing, to lock the plug, and stake into place.

e. Slide the 1$^1/_2$-inch OD knob (B) on the worm shaft. Aline the taper pin holes in the knob with the pin hole in the worm shaft. Support the knob and worm and press or drive in a No. 4/0 x $^5/_8$ taper pin (A). See paragraph 29 for recommended procedure. Test the worm as directed in paragraphs 35 and 36. When the worm movement is satisfactory, stake the set screws.

104. Installation of the Nameplate
(fig. 39)

Position the nameplate on the telescope support housing bracket and secure in position with two No. 5 (0.125) x $^1/_4$ round-head screws. Tighten the screws securely.

105. Installation of the Instrument Light Clamp Assembly
(fig. 39)

Position the instrument light clamp assembly on the telescope support housing bracket. Secure clamp assembly in position with four No. 8 (0.164) x $^3/_8$ round-head screws and four No. 8 (0.164) light lock washers. Tighten the four screws securely.

106. Installation of the Telescope Holder Assembly
(fig. 39)

a. Lubricate (par. 26) the bearing surfaces of the telescope holder assembly. Slide the telescope holder assembly (fig. 39) into the telescope holder support.

Note. Use care so as not to nick or bur the bearing surfaces.

With a spanner wrench, screw the 1 x $^7/_{16}$ brass plug into the telescope holder assembly. Tighten the plug until the screw hole in the plug alines with the drill-point in the telescope holder. Rotate the holder; the movement should be smooth without any binding or endplay. If any binding or endplay is indicated, the plug must be adjusted. While rotating the holder, loosen or tighten the plug until the holder functions correctly. If the set screw holes are out of alinement, a new hole must be drilled. Using a No. 29 drill, drill a hole 180° from the original hole in the plug and drill-point the holder. Thread the hole

with a No. 8–36NF–3 tap. Screw the No. 8 (0.164) x 5/32 headless set screw into the plug and tighten it securely.

b. Insert the 1/2 x 2 1/4 hex-head cap screw in the telescope holder support. Slide a 1/2-inch medium lock washer on the cap screw. Screw a 1/2-inch regular hex nut on the cap screw and tighten securely.

c. Lubricate (par. 26) the 2 1/8-inch long worm and insert it in the telescope holder support. Press the 7/8-inch OD brass collar on the protruding end of the worm. Aline the pin holes in the worm and collar. Support the worm and collar and press or drive in the 3/32 x 7/8 straight pin, to secure the collar to the worm. Loosen the clamping screw and, with a screwdriver, rotate the worm several turns. The worm may have to be lapped to the telescope holder assembly (par. 40). Fill all set screw holes with the proper sealing and plugging cement (ORD 3 SNL K–1).

107. Test and Adjustments

a. Test of the Worm Mechanisms.

(1) Elevation worm (par. 102*e*).

(2) Telescope holder worm (par. 106*c*).

(3) Telescope holder support housing worm (par. 102*e*).

b. Test for Backlash. See paragraphs 19*b* and 41.

c. Test for Clicking, Binding, etc. See paragraphs 34 through 44 on general maintenance for test and adjustment of worm mechanisms in general.

d. Adjustment of Plug and Round Nuts.

(1) Telescope holder plug (par. 103*d*).

(2) Telescope holder support round nut (par. 102*b*).

(3) Telescope holder support housing round nut (par. 102*b*).

108. Installation to the On-Carriage Position

a. Work the telescope support housing bracket on the trunnion extension, alining the holes for the dowel pin. Drive in a 3/8 x 3/4 straight pin.

b. Slide a 3/8-inch medium lock washer on each of the six 3/8 x 7/8 hex-head cap screws. Insert the screws in the bracket and tighten them securely into the weapon.

Section VI. TELESCOPE MOUNT M32

109. General

This section contains the procedure for removal, disassembly, rebuild, assembly, test and adjustment, and installation of the telescope mount M32.

110. Removal From the On-Carriage Position

a. Remove the 10 hex-head cap screws (D and E, fig. 41) that secure the telescope mount to the side of the elevating mechanism of the gun mount.

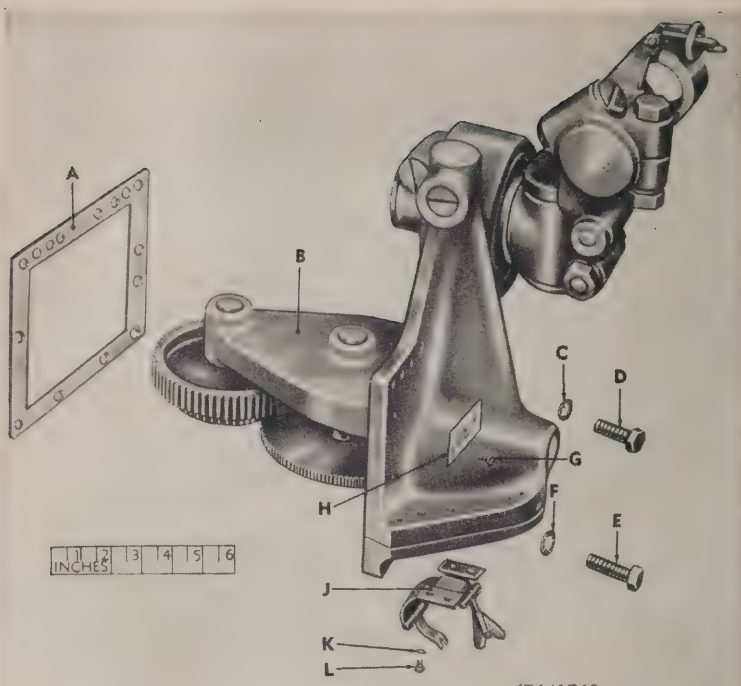

Figure 41. Telescope mount M32—removal of mount and components—exploded view.

b. Carefully lift the mount from its on-carriage position.

Note. Be careful not to damage the gear teeth of the telescope mount or the elevating mechanism of the gun. Carefully remove the shims (A, fig. 41) from the mount.

111. Removal of the Instrument Light Clamp Assembly (fig. 41)

Remove the four round-head screws (L) that secure the instrument light clamp assembly to the elevating gear housing cover of the tele-

scope mount. Lift the clamp assembly (J) from the cover. Slide the four lock washers (K) from the round-head screws.

112. Removal of the Nameplate
(fig. 41)

Remove the two round-head screws (F) that secure the nameplate to the housing. Lift the nameplate (H) from the housing.

113. Removal of the Elevating Gear Housing Cover
(fig. 42)

a. Remove the six fillister-head screws that secure the elevating gear housing cover to the housing.

b. Pry the cover from the two straight pins that locate the cover on the housing. Remove the two straight pins from the housing. Pull the cover gasket from the groove in the housing.

114. Disassembly of the Elevating Gear Housing Assembly

a. Removal of the Gear Train.

Note. Before removing the gears, scribe marks so they will be returned to their proper place (par. 24*b*).

(1) Support the spur gear shaft (fig. 42) and press or drive out the taper pin (fig. 42) that secures the shaft in the housing. With the use of a wood drift, press the shaft and 4.562-inch OD spur gear out of the housing. Pull the gear (fig. 42) from the shaft. Remove the snap ring and washer from the shaft.

(2) Support the second spur gear shaft (fig. 42) and press or drive out the taper pin (par. 30) that secures the shaft in the housing. With the use of a wood drift, press the shaft and 4.125-inch OD spur gear from the housing. Pull the gear (fig. 42) from the gear shaft. Remove the snap ring and washer from the shaft.

(3) The bearings in each of the spur gears should not be removed unless damaged. If removal is necessary, press out the bearings.

(4) Remove the jam nut that secures the 2.812-inch OD spur gear to the elevating worm (fig. 42). Slide the lock washer and spur gear (fig. 42) from the worm.

b. Removal of the Elevating Worm and Related Parts (fig. 43).

(1) Remove the headless set screw that locks the $\frac{7}{8}$ x $\frac{1}{4}$ round plug in the housing. Unscrew the plug from the housing. Extract the compression spring and worm plunger from the housing.

(2) Remove the 1 x $\frac{11}{32}$ round plug in the top of the gear housing.

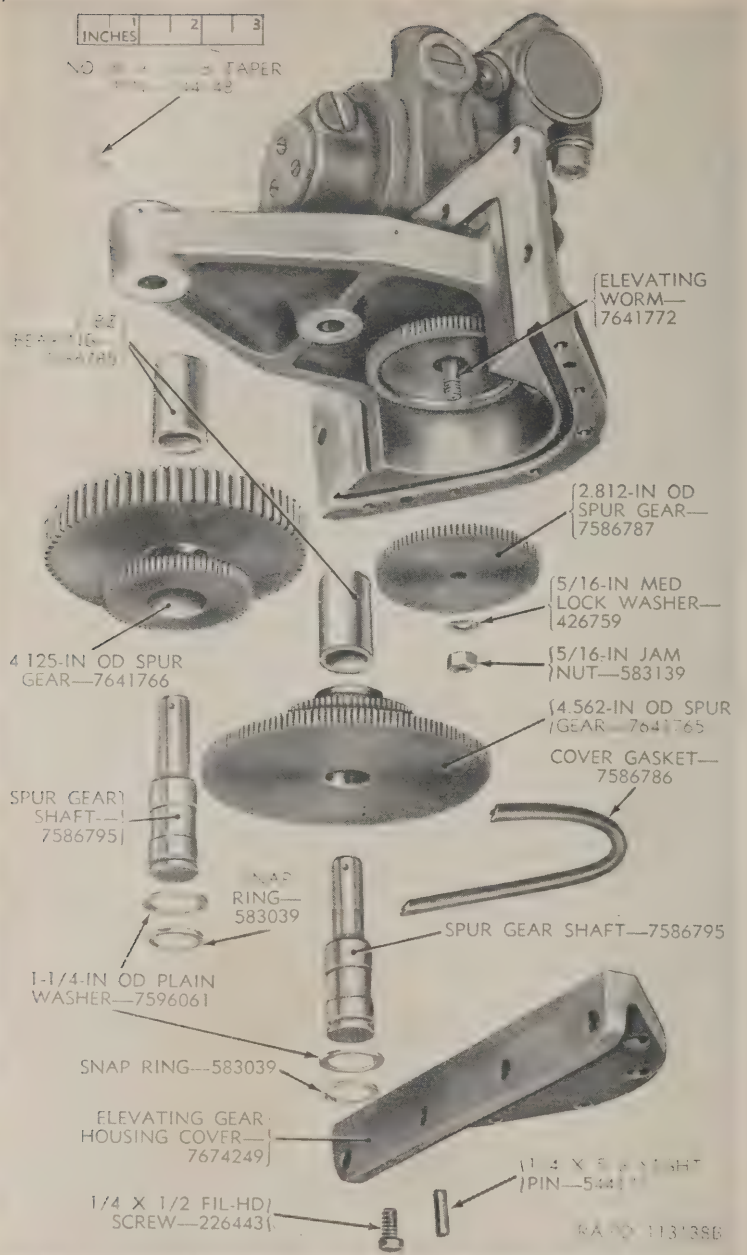

Figure 42. Telescope mount M32—removal of the elevating gear housing cover and spur gears from the housing—exploded view.

(3) Remove the 1 x $1\frac{1}{32}$ round plug that gives access to the special screw that locks the elevating worm ball socket in the housing. Remove the special screw from the housing and unscrew the elevating worm ball socket.

(4) Loosen the headless special screw that positions the $\frac{15}{16}$-inch ball socket in the housing. Rotate the elevating worm and extract the worm and ball socket from the housing. Slide the ball socket from the elevating worm.

Note. The ball sockets have plastic inserts and should not be disassembled.

c. Removal of the Telescope Holder Support Assembly (fig. 44).

(1) Support the collar on the end of the worm in the elevating worm gear spindle. Press or drive out the straight pin that secures the collar to the worm. Pull the collar from the worm. Unscrew and remove the worm from the spindle by rotating it with a screwdriver.

(2) Unscrew the hex nut from the hex-head cap screw (clamping screw). Slide the lock washer from the screw and extract the cap screw from the spindle.

(3) Unscrew the three flat-head screws that secure the retainer to the bottom side of the telescope holder support assembly. Remove the retainer and carefully slide the telescope holder support assembly out of the elevating worm gear spindle.

d. Removal of the Elevating Worm Gear Spindle (fig. 44).

(1) Support the collar on the end of the worm and press or drive out the straight pin that secures the collar to the worm. Pull the collar from the worm. Unscrew the worm from the elevating worm gear.

(2) Unscrew the hex-head cap screw (clamping) from the elevating worm gear. Slide the lock washer from the cap screw.

(3) Remove the three flat-head screws that secure the retainer to the spindle. Remove the retainer and carefully slide the spindle out of the elevating worm gear.

e. Removal of the Elevating Worm Gear (fig. 45).

(1) Remove the headless set screw that locks the retaining ring in the elevating worm gear housing. Using the proper size spanner wrench, unscrew the retaining ring from the elevat- gear housing.

(2) Press the elevating worm gear from the housing.

Note. Use care so as not to damage the bearing surfaces of the housing or gear.

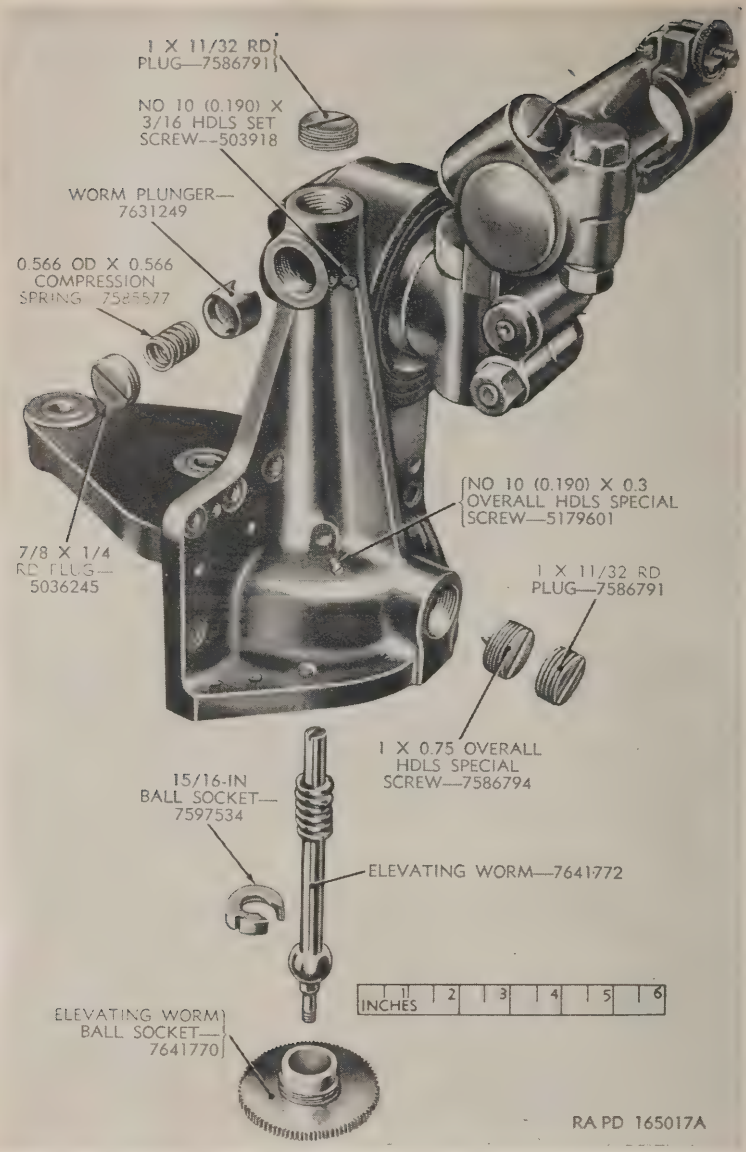

Figure 43. Telescope mount M32—removal of the elevating worm and related parts—exploded view.

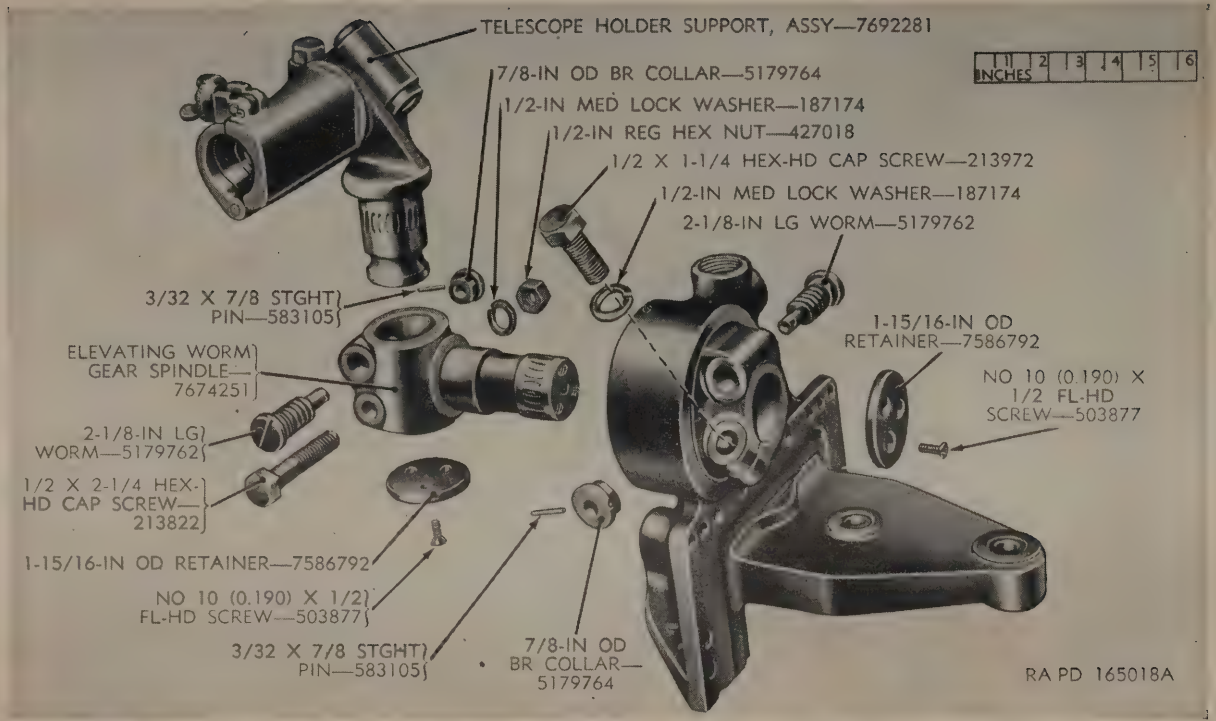

Figure 44. Telescope mount M32—removal of the telescope holder support assembly and elevating worm gear spindle—exploded view.

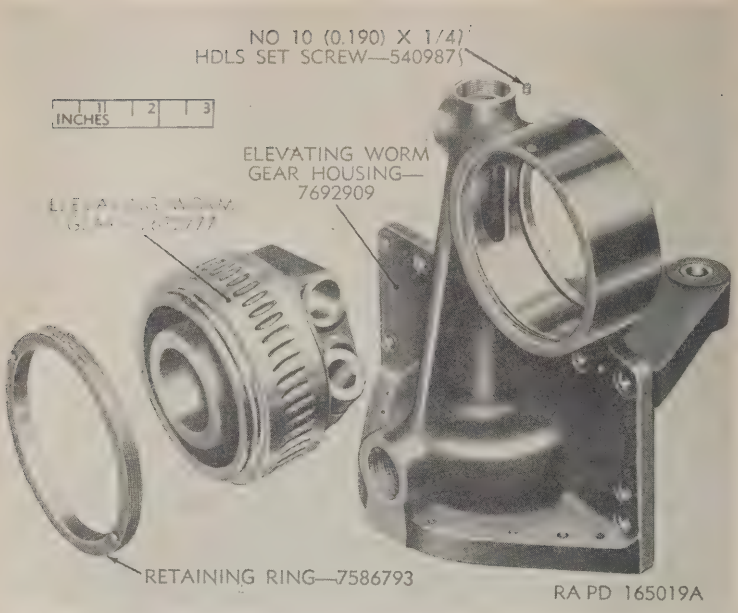

Figure 45. Telescope mount M33—removal of the elevating worm gear—exploded view.

115. Disassembly of the Telescope Holder Support Assembly (fig. 46)

a. Properly support the collar on the end of the worm in the telescope holder support. Press or drive out the straight pin (fig. 46) that secures the collar to the worm. Pull the collar from the worm. Unscrew the worm from the telescope holder support.

b. Remove the headless set screw that locks the plug in the telescope holder assembly. With a spanner wrench, unscrew the plug from the telescope holder.

c. Remove the hex nut on the end of the hex-head cap screw (clamping screw). Slide the lock washer from the screw and extract the screw from the telescope holder support. Carefully slide the telescope holder assembly from the telescope holder support.

116. Disassembly of the Telescope Holder Assembly

For disassembly of the telescope holder assembly, which is identical to the telescope holder assembly on the telescope mount M28 (fig. 35), see paragraph 72.

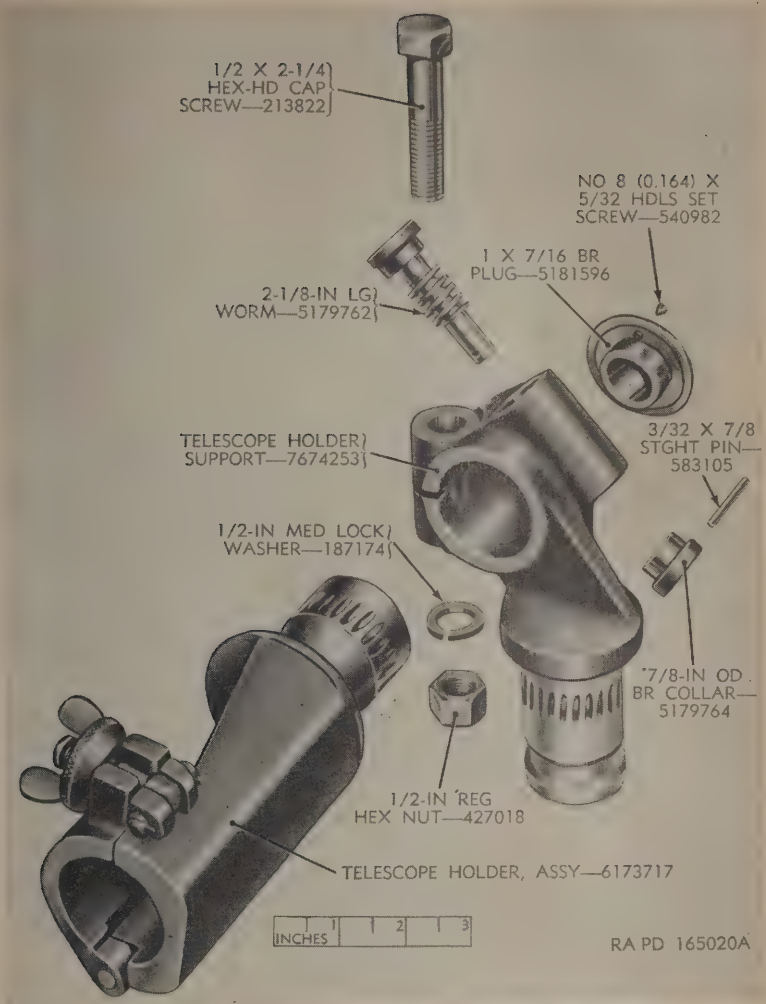

Figure 46. Telescope mount M32—telescope holder support assembly—exploded view.

117. Disassembly of the Instrument Light Clamp Assembly

For disassembly of the instrument light clamp assembly, which is identical to the instrument light clamp assembly on the telescope mount M31 (fig. 39), see paragraph 98.

118. Rebuild

a. General. All component parts having seating, locating, or bearing surfaces must be free of nicks, burs, or other deformities. On all

threaded components, the threads must not be crossed or damaged. It is very important that the in-process inspection be of the highest standards, since final acceptance of the assembled materiel depends largely upon the care exercised during the in-process inspection.

b. Gasket. If the gasket is damaged or brittle, it must be replaced.

c. Instrument Light Clamp Assembly. Any nicks or bends may be hammered out. Remove all rust and corrosion (par. 24*d*).

d. Nameplate. The lettering on the nameplate must be clean and distinct.

e. Worms. Rebuild the worms as in paragraphs 35, 36, and 40. If any worm is worn to a knife edge, it must be replaced.

f. Spur Gears. Clean the teeth of the gear. Remove all nicks or burs as in paragraph 24*c*. Be sure the gears are not bent or distorted.

g. Ball Sockets. See paragraph 37.

Note. The ball sockets in this mount have plastic inserts and should not be lapped to the worm ball.

h. Spring Specifications. Table V lists the standards for new coil springs. Replace the spring if it is corroded, set, weak, distorted, or fails to meet these standards (par. 45).

Table V. Spring Standards

Spring	Part No.	Number of coils	Solid height (in.)	Load at solid height (lb.)	Operating height (in.)	Load at operating height (lb.)
Compression	7585577	5	0. 315	18. 5±2	0. 406	14. 5±1. 5

i. Elevating Gear Housing. Chase all threaded surfaces of the housing with the proper size thread chaser. Remove all rust or corrosion (par. 24*d*). The base of the housing must be smooth.

j. Hobbed Surfaces. Clean all hobbed surfaces on the spindle, support, and elevating gear; inspect for excessive wear; and remove all nicks or burs (par. 24*c*).

k. Cleaning. Clean all components of the mount as detailed in paragraph 25.

119. Assembly of the Instrument Light Clamp

For assembly of the instrument light clamp assembly, which is identical to the instrument light clamp assembly on the telescope mount M31 (fig. 39), see paragraph 100.

120. Assembly of the Telescope Holder

For assembly of the telescope holder assembly, which is identical to the telescope holder assembly on the telescope mount M28 (fig. 35), see paragraph 82.

121. Assembly of the Telescope Holder Support (fig. 46)

a. Lubricate (par. 26) the hob and bearing surfaces of the telescope holder assembly. Insert the telescope holder assembly into the telescope holder support.

Note. Use care so as not to damage the machined surfaces.

Screw the 1 x 7/16 brass plug in the telescope holder. Tighten the plug with a spanner wrench. Rotate the holder. The movement should be smooth and even, without binding or endplay. Tighten or loosen the plug until all binding or endplay is removed and the telescope holder functions properly. If the set screw holes are alined, insert a No. 8 (0.164) x 5/32 headless set screw and tighten securely. If the set screw holes do not aline or if a new plug is used, a new hole must be drilled. Drill the hole 180° from the original hole, using a No. 29 drill. Drill-point the holder directly under the hole drilled. Tap the hole in the plug with a No. 8–36NF–3 tap. Insert the No. 8 (0.164) x 5/32 headless set screw and tighten securely.

b. Insert the 1/2 x 2 1/4 hex-head cap screw in the telescope holder support. Slide the 1/2-inch medium lock washer on the cap screw and screw on a 1/2-inch regular hex nut. Tighten the nut securely.

c. Screw the 2 1/8-inch long worm into the support, engaging the hobbed surface of the telescope holder. See paragraph 40 for proper fitting. Press the 7/8-inch OD brass collar on the protruding end of the worm. Aline the pin holes in the collar with those in the worm. Press or drive in the 3/32 x 7/8 straight pin. Test the movement of the worm by loosening the cap screw and rotating the worm with a screwdriver.

122. Assembly of the Elevating Gear Housing

a. Installation of the Elevating Worm Gear (fig. 45).

(1) Lubricate (par. 26) the elevating worm gear and the bore of elevating worm gear housing. Carefully slide the elevating worm gear into the housing.

(2) Screw the retaining ring into the housing. Rotate the worm gear while tightening the retaining ring. When the movement of the gear is without binding or end play, no further adjustment of the retaining ring is necessary. Insert the No. 10 (0.190) x 1/4 headless set screw in the top of the housing, to lock the retaining ring in position. Tighten the set screw securely.

b. Installation of the Elevating Worm Gear Spindle (fig. 44).

(1) Properly lubricate (par. 26) the hob and bearing surface of the elevating worm gear spindle and the internal bearing surfaces of the elevating worm gear. Carefully insert the spindle in the elevating worm gear. Position the 1 15/16-inch

OD retainer on the elevating worm gear spindle and secure with three No. 10 (0.190) x ½ flat-head screws.

(2) Place a ½-inch medium lock washer on the ½ x 1¼ hex-head cap screw. Screw the cap screw into the elevating worm gear. Tighten the cap screw securely, thereby clamping the spindle.

(3) Lubricate (par. 26) the 2⅛-inch long worm and screw the worm into the elevating worm gear. The worm must engage with the hob of the elevating worm gear spindle (par. 40). Press the ⅞-inch OD brass collar on the protruding end of the worm. Aline the pin holes in the collar with the pin hole in the worm. Press or drive in the 3/32 x ⅞ straight pin, to secure the collar to the worm.

c. Installation of the Telescope Holder Support Assembly (fig. 44).

(1) Properly lubricate (par. 26) the hob and bearing surface of the telescope holder support assembly. Slide the telescope holder support assembly into the elevating worm gear spindle. Position the 1 15/16-inch OD retainer on the support. Insert and tighten the three No. 10 (0.190) x ½ flat-head screws, to secure the retainer to the support.

(2) Insert the ½ x 2¼ hex-head cap screw into the elevating worm gear spindle. Place a ½-inch medium lock washer on the cap screw. Screw a ½-inch regular hex nut on the cap screw. Tighten the hex nut securely, thereby clamping the telescope holder support assembly into the spindle.

(3) Lubricate (par. 26) the 2⅛-inch long worm and screw the worm into the elevating worm gear spindle. Check to see that the worm properly meshes with the hob of the telescope holder support (par. 40). Press a ⅞-inch OD brass collar on the protruding end of the worm. Aline the pin holes in the collar with the pin hole in the worm. Press or drive in a 3/32 x ⅞ straight pin to secure the collar to the worm.

d. Installation of the Elevating Worm and Related Parts (fig. 43).

(1) Properly lubricate (par. 26) the elevating worm and 15/16-inch ball socket. Slide the ball socket on the elevating worm between the worm ball and the worm thread. Insert the worm and ball socket into the housing. Insert the worm from the underside up into the housing until the worm thread engages with the elevating worm gear; rotate the worm, if necessary, to properly seat the ball socket and worm in the housing.

(2) Position the ball socket, so that the slot in the socket is directly under the hole for the special screw. Screw the No. 10 (0.190) x 0.3 overall headless special screw into the housing, engaging the dog point into the slot in the socket. Tighten the screw; then loosen it slightly.

(3) Lap (pars. 38 and 39) the worm plunger to the housing and worm shaft. Lubricate (par. 26) the plunger and insert it into the housing, with the forked end over the worm. Test the compression spring according to the standards in table V. If the spring meets the specifications or if a new spring is used, lubricate (par. 26) the spring, and insert it in the plunger. Screw the 7/8 x 1/4 round plug in the housing, to retain the spring. Screw the No. 10 (0.190) x 3/16 headless set screw into the housing, to lock the plug. Do not tighten the set screw at this time.

(4) Slide the elevating worm ball socket on the elevating worm and screw it into the housing. Adjust the elevating worm ball socket until the movement of the worm is without endplay or binding. At the same time, adjust the worm plunger. Insert a screwdriver in the top of the housing to rotate the worm. While rotating the worm, tighten or loosen the plug that retains the spring and plunger until the movement of the worm and elevating worm gear is smooth and even without endplay or binding. When the adjustment is satisfactory, screw the 1 x 0.75 overall headless special screw into housing. Screw the 1 x 11/32 round plug into the housing, tight against the special screw. The plug functions as a lock for the screw. Tighten the setscrew that secures the 7/8-inch plug holding the compression spring. Screw the 1 x 11/32 round plug into the top of the housing. Tighten the plug securely.

e. Installation of the Gear Train.

Note. When installing the spur gears, aline the scribe marks (par. 24*b*) that were made at the time of removal.

(1) Lubricate (par. 26) the 2.812-inch OD spur gear (fig. 42) and slide the gear on the elevating worm (fig. 42). The key on gear must enter the keyway of the worm. Slide the 5/16-inch medium lockwasher (fig. 42) on the worm and screw a 5/16-inch jammut (fig. 42) on the worm. Tighten the jammut securely against the washer and spur gear.

(2) If replacement is required, press in new phosphor bronze bearings (fig. 42) into the spur gears. Install a 1¼-inch OD plain washer and snap ring on each of the spur gear shafts (fig. 42). Lubricate (par. 26) the 4.125-inch OD spur gear (fig. 42) and one of the shafts. Press the spur gear shaft into the spur gear and housing and secure with a No. 00 x 1⅛ taper pin (fig. 42).

(3) Lubricate the 4.562-inch OD spur gear and the second spur gear shaft. Position the spur gear on the housing, alining the scribe marks, and press the shaft into the gear and hous-

ing. Secure the shaft to the housing with a No. 00 x 1⅛ taper pin (fig. 42).

123. Installation of the Elevating Gear Housing Cover (fig. 42)

a. Apply a coating of the proper oil resistant cement (ORD 3 SNL K–1) to the cover gasket, then press the gasket into the groove in the housing. Install a new gasket if the old one is damaged.

b. Insert the two ¼ x ⅝ straight pins into the unthreaded holes in the housing. Press the elevating gear housing cover on the two ¼ x ⅝ straight pins. Insert the six ¼ x ½ fillister-head screws in the cover and tighten securely into the housing. If a new cover is used, follow this procedure: Position the cover on the housing. Insert the six fillister-head screws; tighten the screws securely. Aline the internal surfaces of the cover and housing. Drill and ream for two ¼-inch diameter straight pins. Drive in the two straight pins.

124. Installation of the Nameplate (fig. 41)

Place the nameplate (H) in position on the elevating gear housing assembly and secure with two No. 5 (0.125) x 3/16 round-head screws. Tighten the screws securely.

125. Installation of the Instrument Light Clamp Assembly

Position the instrument light clamp assembly (J, fig. 41) on the elevating gear housing cover (fig. 42) and secure with four No. 8 (0.164) x ⅜ round-head screws and four No. 8 (0.164) light lock washers.

126. Tests and Adjustments

a. Test of Movement of the Boresighting Worms. Loosen the three hex-head cap screws (figs. 44 and 46) that clamp the worms. With the use of a screwdriver, rotate the worms through their full turn. The movement should be smooth and without any binding or endplay (par. 40).

b. Test for Backlash in the Elevating Worm Mechanism.

(1) Remove the 1 x 11/32 round plug in the top of the housing (fig. 43).
(2) Scribe coincident lines on the spur gears (fig. 42).
(3) Scribe a mark on the top of the elevating worm and inside the housing.
(4) Insert a screwdriver in the top of the housing, engaging the slot in the elevating worm.
(5) Rotate the worm 90° from the scribe marks. Rotate back and match the scribe lines on the worm housing.

(6) Check the position of the scribe lines on the gear train. The lines should coincide; if they do not, record the difference in inches. Repeat the procedure several times, each time recording the difference in the scribed lines on the gear train.

(7) Only initial backlash is allowed between these gears. Excessive backlash should be removed by adjusting the worm mechanism (par. 41).

c. Sealing. After all tests and adjustments have been made, the screw holes in (1) through (3) below must be plugged and sealed with the proper sealing and plugging cement (ORD 3 SNL K–1).

(1) The special screw that locates the $^{15}/_{16}$-inch ball socket (fig. 43).

(2) The 1-inch plug that locks the special screw in the housing (fig. 43).

(3) The 1-inch plug at the top of the housing.

d. Staking. The screws in (1) and (2) below must be staked (par. 47).

(1) The headless set screw that locks the $^{7}/_{8}$ x $^{1}/_{4}$ round plug in the housing (fig. 43).

(2) The headless set screw that locks the retaining ring in the housing (fig. 45).

127. Installation to the On-Carriage Position

a. Place the elevating handwheel gear cover shim (A, fig. 41) on the housing assembly.

Note. The thickness of the shim must be sufficient to eliminate binding or backlash between the drive gear in the elevating housing and the first gear on the weapon.

Apply a film of the proper oil-resistant cement (ORD 3 SNL K–1) to the gasket in the elevating handwheel gear housing cover on the gun mount.

b. Position the telescope mount in the side of the elevating mechanism of the gun mount and secure in position with six $^{5}/_{16}$ x $^{7}/_{8}$ hex-head cap screws (E, fig. 41) in the housing assembly and four $^{5}/_{16}$ x $1^{1}/_{2}$ hex-head cap screws (D, fig. 41) in the elevating gear housing cover. Place a $^{5}/_{16}$-inch medium lock washer on each of the 10 screws. In placing the screws in the housing, start at the right-hand side. Insert one screw, skip a hole, and insert two screws in the next two holes. Repeat this procedure for the left side of the housing. Tighten the 10 cap screws securely.

c. After installation, check the mount for total backlash. This can be done by boresighting the mount to the weapon. When the mount and gun are properly boresighted, elevate the gun 10°. Bring the gun back to its original position. Observe the target through the telescope mounted on the telescope mount M32. The horizontal line

should be directly on the target. (Target will be the same as that used for boresighting.) Repeat the procedure four or five times, each time measuring the differences in the telescope and weapon by using a gunner's quadrant. Use the weapon as the true reference. Backlash can be minimized by adjusting the elevating mechanism and/or inserting shims.

Section VII. TELESCOPE MOUNT M42

128. General

This section contains the procedure for removal, disassembly, rebuild, assembly, tests and adjustments, and installation of the telescope mount M42 (fig. 13).

129. Removal From the On-Carriage Position (fig. 47)

a. Remove the two hex-head cap screws and lock washers that secure the telescope holder mounting bracket of the telescope mount in position on the range quadrant M4 or M4A1 bracket.

b. Press or drive out the taper pin that locks the threaded portion of the adapter in the quadrant bracket; then, unscrew and remove the telescope mount.

Note. In some of the earlier models, a headless set screw is used instead of the taper pin.

130. Removal of the Instrument Light Clamp Assembly (fig. 48)

Remove the two round-head screws and hex nuts that secure the clamp assembly to the instrument light clamp mounting bracket. Remove the lock washers from the two screws. Lift the instrument light clamp assembly from the mounting bracket.

131. Removal of the Instrument Light Clamp Mounting Bracket (fig. 48)

Remove the three round-head screws and lock washers that secure the instrument light clamp mounting bracket to the mount. Remove the instrument light clamp mounting bracket.

132. Removal of the Telescope Holder Assembly and Related Parts

a. Loosen the two jam nuts on the two headless special screws (fig. 50) in the telescope holder adjusting bracket. Loosen nuts just enough for the holder assembly to clear the bracket.

b. Unscrew the hex nut (fig. 49) from the telescope holder stud (figs. 49 and 51) and remove the plain washer (fig. 49).

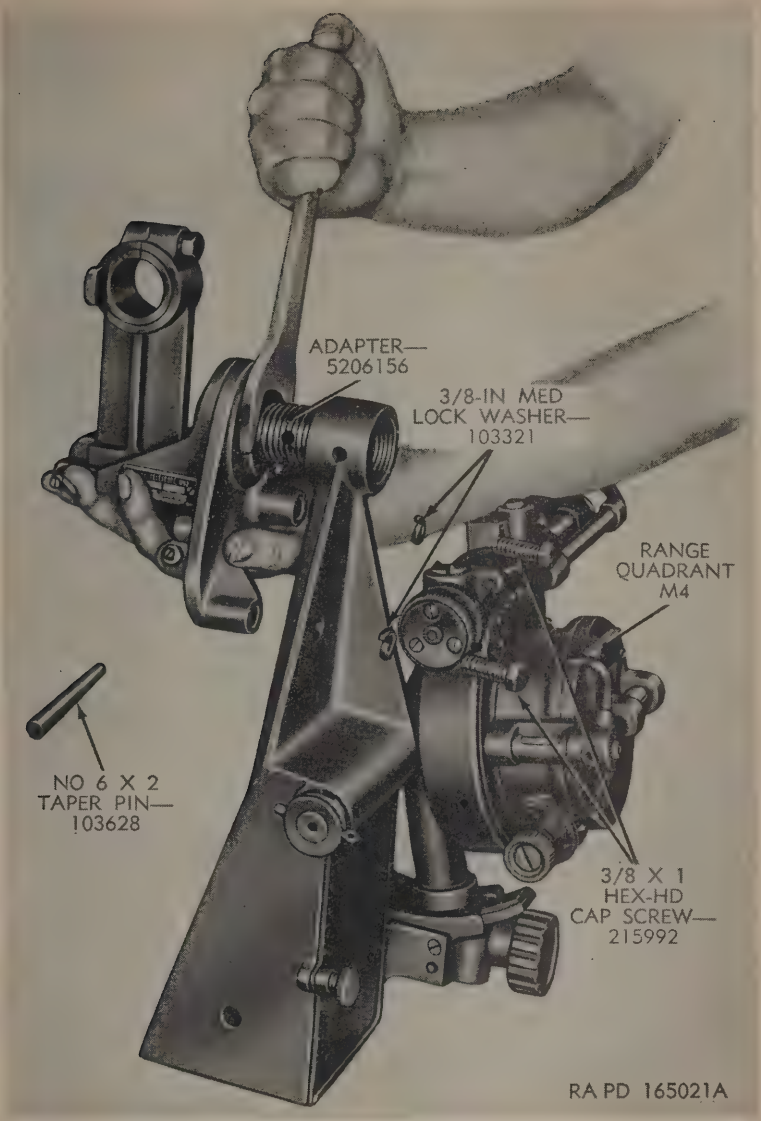

Figure 47. Telescope mount M42—removal from the on-carriage position.

c. Remove the hex-head cap screw (fig. 49) that passes through the tlescope holder adjusting bracket into the telescope holder. Remove the plain washer and the lock washer (fig. 49) from the screw.

d. Lift the telescope holder assembly (fig. 49) from the telescope holder adjusting bracket.

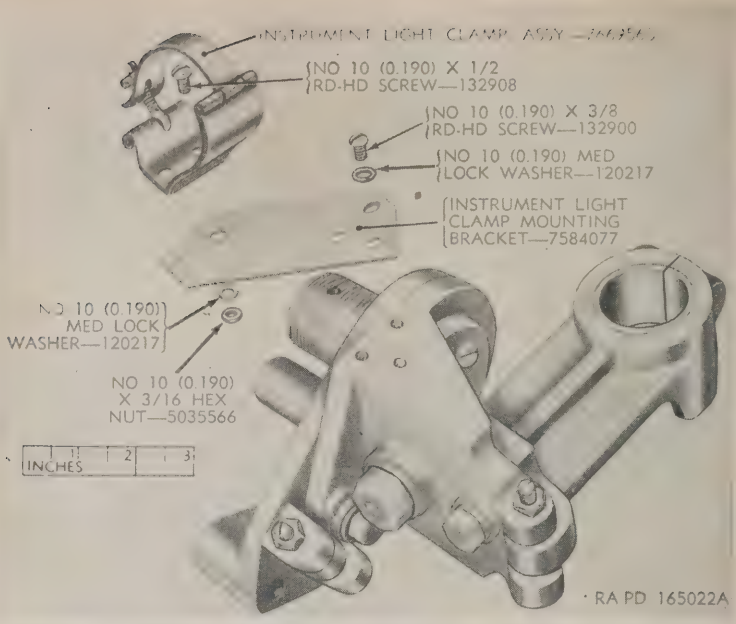

Figure 48. Telescope mount M42—removal of the instrument light clamp assembly and related parts—exploded view.

133. Removal of the Adapter

(fig. 50)

Remove the three flat-head screws that secure the disk to the inner end of the adapter. Remove the disk and press the adapter from the bracket.

134. Removal of the Nameplate

(fig. 50)

Remove the two round-head screws that secure the nameplate to the telescope holder adjusting bracket and lift the nameplate from the bracket.

135. Removal of the Telescope Holder Adjusting Bracket From the Telescope Holder Mounting Bracket

(fig. 50)

a. Unscrew the four headless screws (adjusting) from the two brackets and unscrew the jam nut from each of the screws.

b. Unscrew the hex-head cap screw that secures the two brackets together. Slide the plain washer and lock washer from the cap screw. Separate the telescope holder adjusting bracket from the telescope holder mounting bracket.

Note. Do not remove the two shoes from the telescope holder mounting bracket, since they are staked in place.

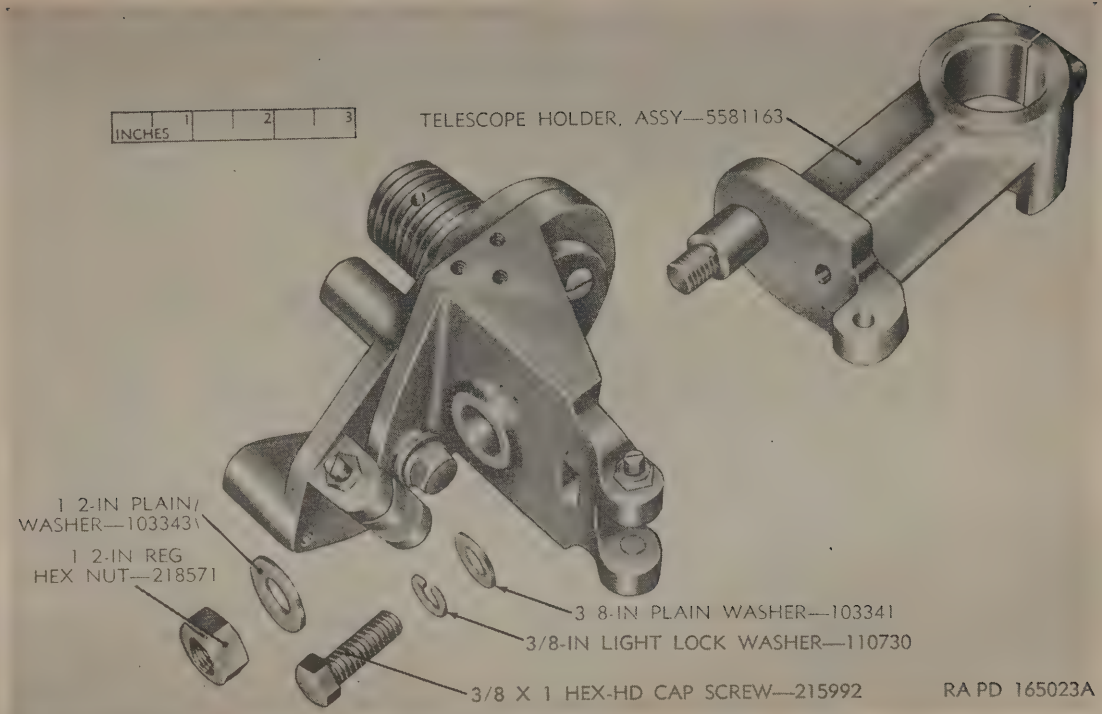

Figure 49. Telescope mount M42—removal of the telescope holder assembly and related parts—exploded view.

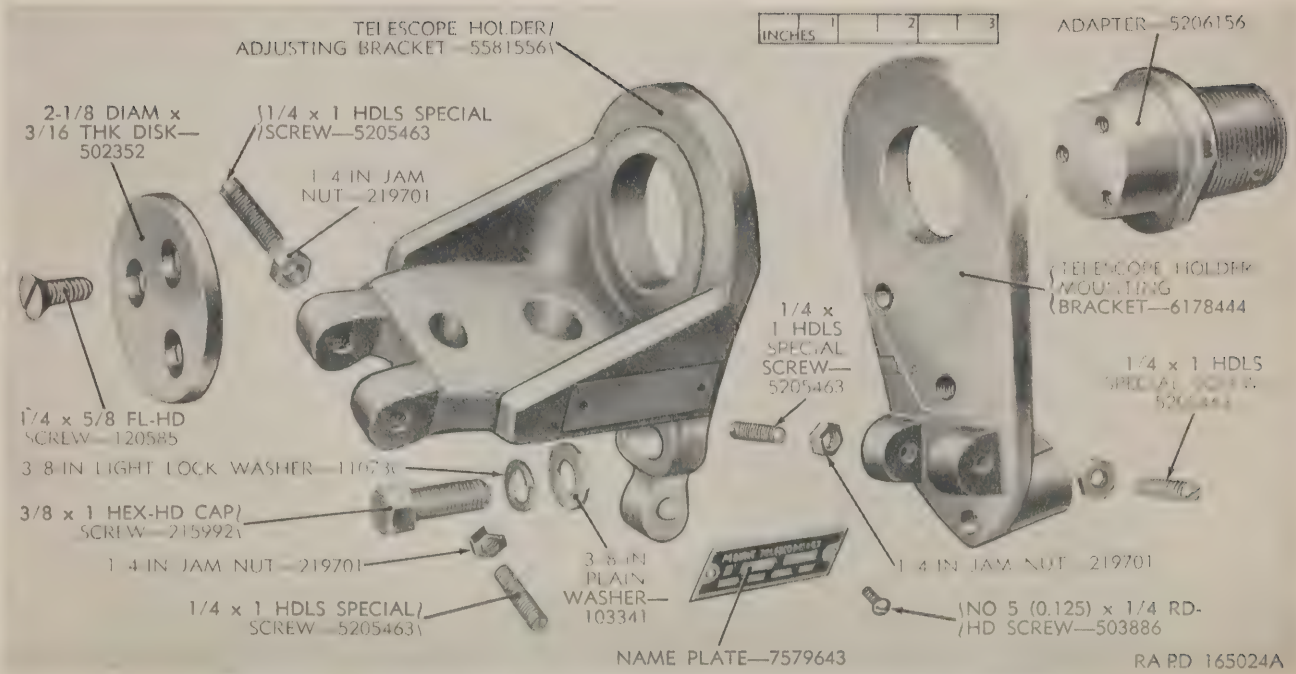

Figure 50. Telescope mount M42—major components of the mount—exploded view.

136. Disassembly of the Telescope Holder Assembly (fig. 51)

a. Press or drive out the straight pin (fig. 51) that locks the stud in place; then unscrew the stud from the holder.

b. Unscrew the hex-head cap screw from the upper end of the telescope holder.

Note. The two steel shoes in the lug of the holder must not be removed.

c. Press the bushing from the telescope holder. The bushing will come out in two parts.

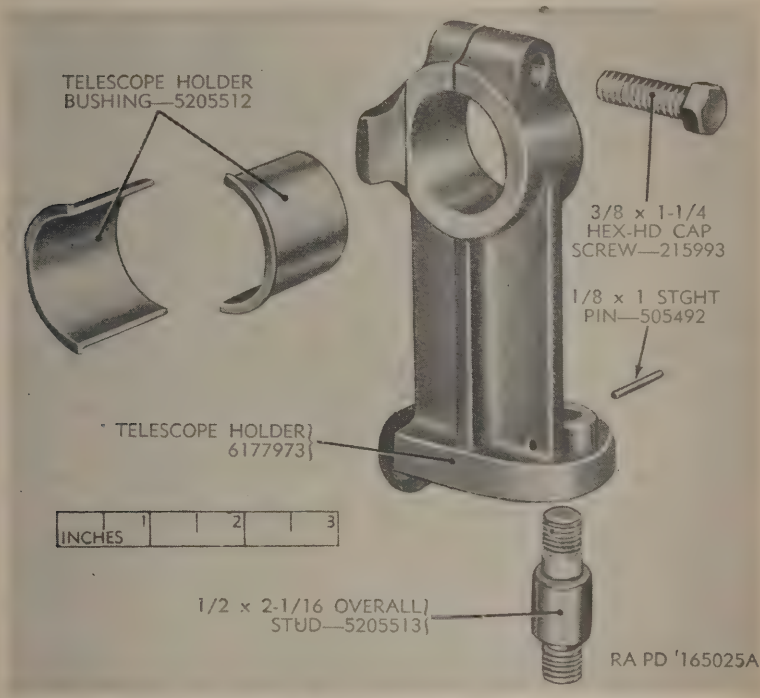

Figure 51. Telescope mount M12—telescope holder assembly—exploded view.

137. Disassembly of the Instrument Light Clamp Assembly

For disassembly of the instrument light clamp assembly, which is identical to the instrument light clamp assembly on the telescope mount M23 (fig. 28), see paragraph 52.

138. Rebuild

a. Remove all nicks or burs (par. 24*c*) from all components.

b. Remove all rust or corrosion (par. 24*d*). Be sure all machined surfaces have a smooth finish.

c. Chase all threaded components with the proper size thread chaser. Screws that are damaged or crossed must be replaced.

d. The nameplate lettering must be clear and distinct.

e. The steel shoes in the telescope holder and telescope holder mounting bracket must not be loose.

f. The instrument light bracket and clamp must not be bent or nicked. Bends or nicks may be hammered out.

g. Clean all components as in paragraph 25.

139. Assembly of the Instrument Light Clamp

For assembly of the instrument light clamp assembly, which is identical to the instrument light clamp assembly on the telescope mount M23 (fig. 28), see paragraph 61.

140. Assembly of the Telescope Holder
(fig. 51)

a. Screw the $\frac{1}{2}$ x $2\frac{1}{16}$ overall stud tightly into the telescope holder and press in a $\frac{1}{8}$ x 1 straight pin. Stake both ends of the pin. If a new stud is used, it will be necessary to drill and ream the hole in the stud for a $\frac{1}{8}$-inch pin at the time of assembly. Make sure that the stud shoulder is tight against the holder before drilling the hole.

b. Screw a $\frac{3}{8}$ x $1\frac{1}{4}$ hex-head cap screw (clamping) in the upper end of the telescope holder.

c. Insert a serviceable bushing (in two parts) in the holder. The flat on the flange of the bushing must be against the lug at the upper end of the holder. Tighten the clamping screw in the holder until the bushing is clamped tight.

141. Installation of the Telescope Holder Adjusting Bracket to the Telescope Holder Mounting Bracket
(fig. 50)

a. Screw each of the two $\frac{1}{4}$ x 1 headless special screws (adjusting) in the adjusting bracket. Screw a $\frac{1}{4}$-inch jam nut on each of the screws.

b. Screw each of the two $\frac{1}{4}$ x 1 headless special screws (adjusting) in the mounting bracket. Screw a $\frac{1}{4}$-inch jam nut on each of the screws.

c. Position the mounting bracket against the adjusting bracket with the adjusting screws against the hard steel shoe. Install a $\frac{3}{8}$-inch lock washer and a $\frac{3}{8}$-inch plain washer on the $\frac{3}{8}$ x 1 hex-head cap screw. Insert the screw through the slot in the adjusting bracket and screw tightly into the mounting bracket.

Note. Make sure that the adapter hole in each bracket is alined.

142. Installation of the Nameplate
(fig. 50)

Position the nameplate on the telescope holder adjusting bracket and secure in position with two No. 5 (0.125) x $\frac{1}{4}$ round-head screws.

143. Installation of the Adapter

(fig. 50)

a. Place the adapter in the hole through the two brackets. The shoulder of the adapter is against the mounting bracket.

b. Position the 2⅛ diameter x 3/16 thick disk against the end of the adapter and the adjusting bracket. Secure the disk to the adapter with three ¼ x ⅝ flat-head screws. Stake the screws to prevent loosening.

144. Installation of the Telescope Holder Assembly and Related Parts

(fig. 49)

a. Place the telescope holder assembly on the adjusting bracket, with the stud through the large hole in the bracket and the lug containing the hardened steel shoes between the adjusting screws.

b. Place a ½-inch plain washer over the holder stud and secure in place by tightly installing a ½-inch regular hex nut. Stake the last thread on the stud to keep the hex nut from working loose.

c. Place a ⅜-inch light lock washer and a ⅜-inch plain washer on the ⅜ x 1 hex-head cap screw. Insert the cap screw up through the slot in the adjusting bracket and screw it tightly into the holder.

d. Adjust the adjusting screws, so that the lug containing the steel shoe will be in the center of travel and the screws against both sides of the shoe; then tighten the jam nuts.

145. Installation of the Instrument Light Clamp Mounting Bracket

(fig. 48)

Position the mounting bracket on the telescope holder adjusting bracket and secure in place with three No. 10 (0.190) x ⅜ round-head screws and three medium lock washers.

146. Installation of the Instrument Light Clamp Assembly

(fig. 48)

Position the instrument light clamp assembly on the mounting bracket and secure it in place with two No. 10 (0.190) x ½ round-head screws, two medium lock washers, and two hex nuts. Tighten the screws and nuts securely.

147. Tests and Adjustments

Tests and adjustments of the telescope mount M42 are performed when boresighting the telescope on the weapon. For adjustment of the special screws (adjusting), see paragraph 144*d*.

148. Installation to the On-Carriage Position
(fig. 47)

a. Screw the telescope mount M42 into the bracket of the range quadrant M4 until the shoulder of the adapter is tight against the quadrant bracket, using an open-end wrench applied to the flats on the adapter. Press or drive in the No. 6 x 2 taper pin into the quadrant bracket and adapter. (See paragraph 29 for the installation of taper pins.)

Note: On some of the earlier mounts, a set screw is used instead of a taper pin.

b. Aline the two 3/8-inch threaded holes in the mounting bracket with the two counterbored 3/8-inch holes in the quadrant bracket. Install two 3/8 x 1 hex-head cap screws, with two medium lock washers, through the quadrant bracket and screw tightly into the mounting bracket of the telescope mount.

Section VIII. TELESCOPE MOUNT M46

149. General

This section contains the procedure for removal, disassembly, rebuild, assembly, test and adjustment, and installation of the telescope mount M46 (fig. 10).

150. Removal From the On-Carriage Position

Remove the four hex-head cap screws, lock washers, and hex nuts in the mounting bracket that secure the telescope mount to the on-carriage position. Carefully lift the mount from the carriage.

151. Removal of the Nameplate
(fig. 52)

Note: Do not remove the nameplate unless damaged.

With a sharp chisel, strike off the heads of the two rivets that secure the nameplate to the mounting bracket. Lift off the nameplate. Press out the remainder of the rivets left in the mounting bracket.

152. Removal of the Telescope Holder Assembly
(fig. 52)

a. Properly support the collar on the end of the worm that rotates the telescope holder assembly, and press or drive out the straight pin that secures the collar to the worm. Pull the collar from the end of the worm and unscrew the worm from the telescope housing.

b. Remove the headless set screw that locks the plug in the telescope holder. Using a spanner wrench, unscrew the plug from the holder.

c. Remove the hex nut on the end of the hex-head cap screw (clamping). Slide the lock washer from the cap screw and extract the screw from the telescope holder housing. Carefully slide the telescope holder assembly from the telescope holder housing.

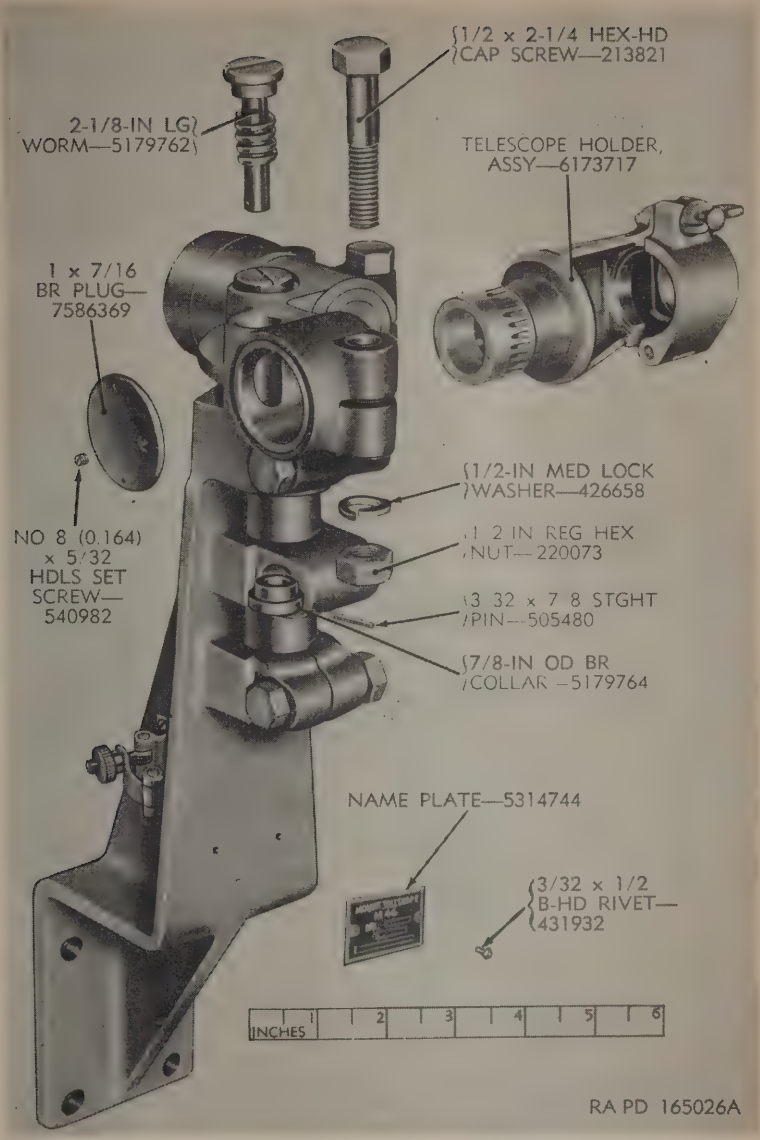

Figure 52. Telescope mount M46—removal of the telescope holder assembly.

153. Removal of the Telescope Holder Housing

(fig. 53)

a. With the collar on the end of the worm properly suported, press or drive out the straight pin that secures the collar to the worm. Pull the collar from the end of the worm. Unscrew the worm from the telescope holder housing.

b. Remove the headless set screw that locks the round nut in the housing. Using a spanner wrench, unscrew the round nut from the spindle assembly and remove it from the housing.

c. Remove the hex nut on the end of the hex-head cap screw (clamping). Slide the lock washer from the clamping screw. Extract the screw from the telescope holder housing. Carefully slide the telescope holder housing from the spindle assembly.

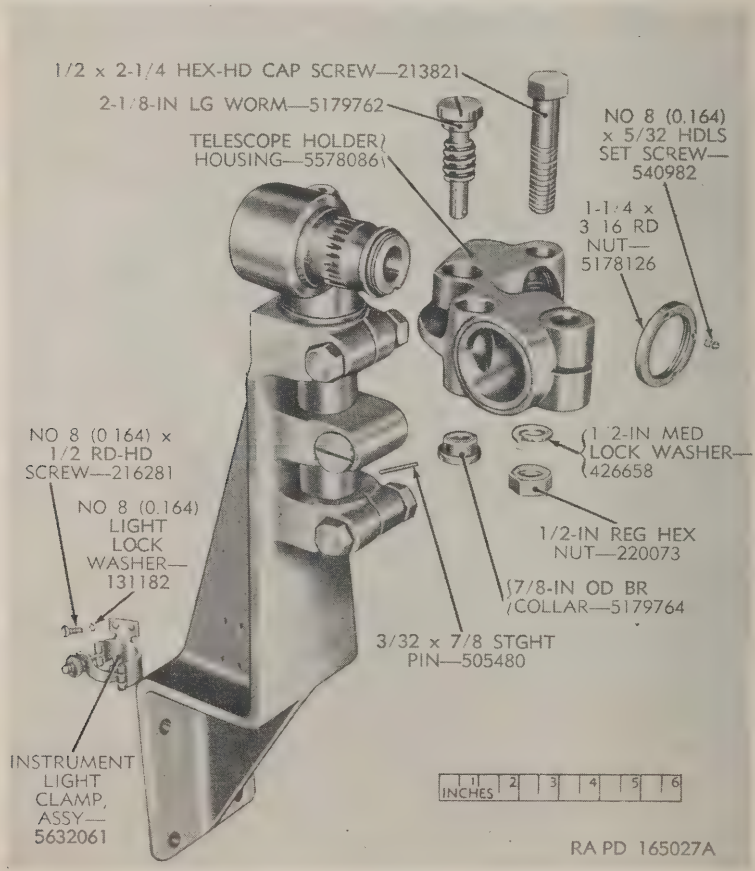

Figure 53. Telescope mount M46—removal of the telescope holder housing.

154. Removal of the Instrument Light Clamp Assembly
(fig. 53)

Remove the four round-head screws and lock washers that secure the clamp assembly to the side of the mounting bracket. Lift the instrument light clamp assembly from the bracket.

155. Removal of the Spindle Assembly
(fig. 54)

a. With the collar on the end of the worm properly supported, press or drive out the straight pin that secures the collar to the worm. Pull the collar from the worm. Unscrew the worm from the mounting bracket and spindle assembly.

b. Remove the headless set screw that locks the round nut on the lower end of the spindle assembly. Using a spanner wrench, unscrew the round nut from the lower end of the spindle.

c. Remove the hex nut on the end of the two hex-head cap screws in the mounting bracket. Slide the lock washer from each of the two cap screws. Extract each of the two screws from the mounting bracket. Carefully slide the spindle assembly out of the mounting bracket.

156. Disassembly of the Spindle Assembly
(fig. 55)

a. With the spindle assembly properly supported, press or drive out the taper pin (par. 30) that secures the worm gear in the spindle.

b. Press the worm gear out of the spindle.

Note. Use care so as not to damage the machined surfaces.

157. Disassembly of the Instrument Light Clamp Assembly

For disassembly of the instrument light clamp assembly, which is identical to the instrument light clamp assembly on the telescope mount M28 (fig. 37), see paragraph 74.

158. Disassembly of the Telescope Holder Assembly

For disassembly of the telescope holder assembly, which is identical to the telescope holder assembly on the telescope mount M28 (fig. 35), see paragraph 72.

159. Rebuild

For rebuild of the components of the telescope mount M46, which are similar to the telescope mount M28, see paragraph 77.

160. Assembly of the Telescope Holder

For assembly of the telescope holder assembly, which is identical to the telescope holder assembly on the telescope mount M28 (fig. 35), see paragraph 82.

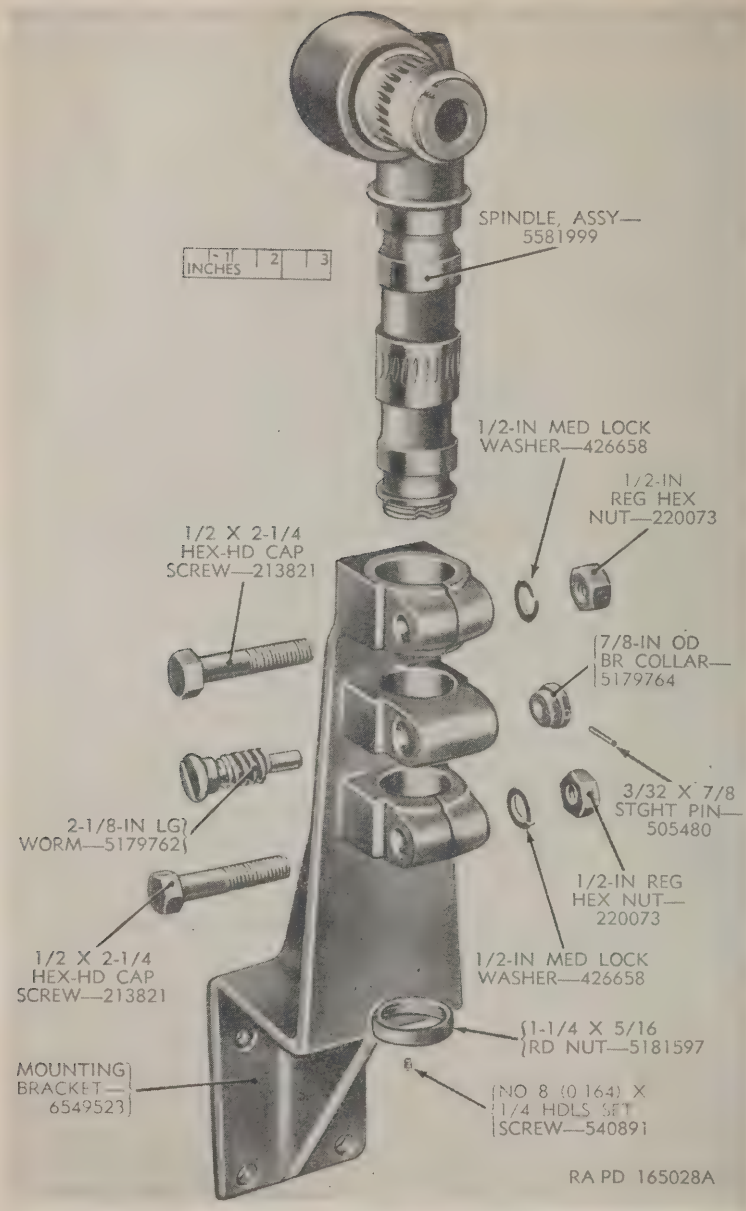

Figure 54. Telescope mount M46—removal of the spindle assembly.

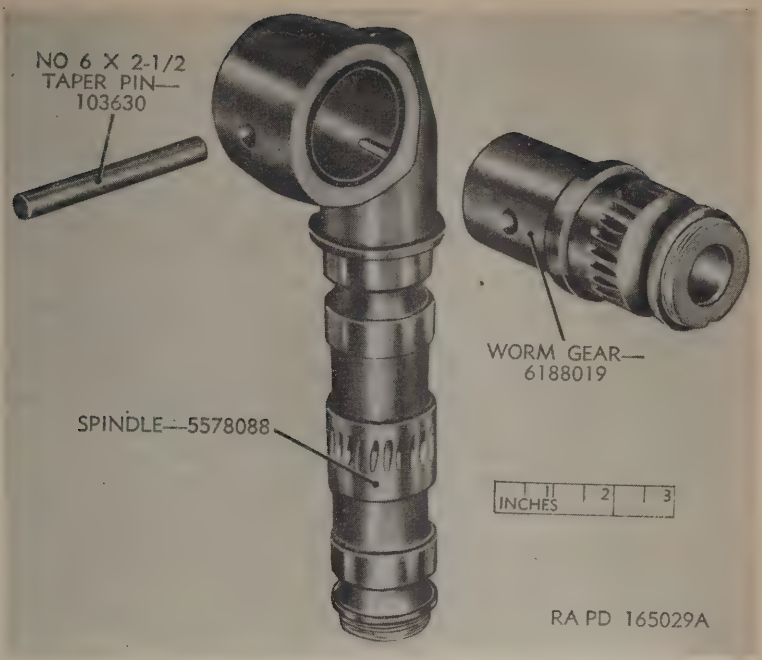

Figure 55. Telescope mount M46—spindle assembly—exploded view.

161. Assembly of the Instrument Light Clamp

For assembly of the instrument light clamp assembly, which is identical to the instrument light clamp assembly on the telescope mount M28 (fig. 37), see paragraph 80.

162. Assembly of the Spindle

(fig. 55)

a. Apply a film of protective lubricant (par. 26) to the worm gear. Press the worm gear in the spindle, alining the holes for the taper pin.

b. Properly support the spindle and worm gear and press or drive in the No. 6 x 2½ taper pin. See paragraph 29 for the installation of taper pins.

Note. If a new worm gear is used, it will be necessary to drill and ream a hole in the worm gear to accommodate a No. 6 taper pin at the time of the assembly (see TM 9–2820 for the proper drill size).

163. Installation of the Spindle Assembly

(fig. 54)

a. Lubricate (par. 26) the internal bearing surfaces of the mounting bracket and the bearing surfaces of the spindle.

Note. Use extreme care, so as not to damage the bearing surfaces.

b. Slide the spindle assembly down into the mounting bracket. Test the movement of the spindle; there should not be any binding when properly lubricated (par. 26).

c. Using a spanner wrench, screw the 1¼ x 5/16 thick round nut on the lower end of the spindle. Tighten the round nut against the spindle. Test the movement of the spindle assembly by rotating it. The movement should be smooth and even, without binding or endplay. If binding or endplay is present, this condition can be removed by adjusting the round nut. While rotating the spindle by hand, loosen or tighten the round nut until the desired movement is obtained. If the set screw holes are alined, screw a No. 8 (0.164) x ¼ headless set screw in the round nut and spindle and tighten securely. If the set screw holes do not aline, a new hole will have to be drilled 180° from the original hole, half in the round nut and half in the spindle. Using a No. 29 drill, tap the hole with a No. 8–36NF–3 tap.

d. Insert each of the two ½ x 2¼ hex-head cap screws, one in the upper and one in the lower hole in the mounting bracket. Slide a ½-inch medium lock washer on each of the two cap screws. Screw a ½-inch regular hex nut on each of the two cap screws. Tighten the screws and nuts securely.

e. Properly lubricate the 2⅛-inch long worm. Screw the worm in the mounting bracket. Press the ⅞-inch OD brass collar on the protruding end of the worm. Aline the holes in the collar with the hole in the worm. Press or drive in the 3/32 x ⅞ straight pin to secure the collar to the worm. Loosen the two hex-head cap screws and, using a screwdriver, rotate the spindle by turning the worm. The movement must be smooth and even.

164. Installation of the Instrument Light Clamp Assembly (fig. 53)

Position the instrument light clamp assembly on the left side of the mounting bracket and secure in place with four No. 8 (0.164) x ½ round-head screws and four light lock washers. Tighten the screws securely.

165. Installation of the Telescope Holder Housing (fig. 53)

a. Lubricate (par. 26) the worm gear on the spindle assembly and the internal bearing surfaces of the telescope holder housing. Carefully slide the housing on the worm gear. Using a spanner wrench, screw the 1¼ x 3/16 round nut on the threaded end of the worm gear. Tighten the round nut. Rotate the housing by hand, to test its movement. There should not be any binding or endplay in the housing. If any binding or endplay is present, adjust the round nut to remove it. While rotating the housing, tighten or loosen the round nut until

the desired movement is obtained. Insert and tighten the No. 8 (0.164) x 5/32 headless set screw that locks the round nut. If the set screw holes in the round nut and worm gear are not alined after adjustment, a new hole must be drilled, half in the worm gear and half in the round nut. Using a No. 29 drill, drill a hole 180° from the original hole. Tap the hole with a No. 8–36NF–3 tap.

b. Insert the 1/2 x 2 1/4 hex-head cap screw in the telescope holder housing. Slide a 1/2-inch medium lock washer on the threaded end of the cap screw. Screw a 1/2-inch regular hex nut on the cap screw and tighten securely.

c. Lubricate (par. 26) and screw the 2 1/8-inch long worm into the telescope housing holder. Press the 7/8-inch OD brass collar on the protruding end of the worm. Aline the holes in the collar with the holes in the worm. Press or drive in the 3/32 x 7/8 straight pin, to secure the collar to the worm. Loosen the clamping screw and rotate the worm with a screwdriver. The movement must be smooth and even without binding or endplay.

166. Installation of the Telescope Holder Assembly

(fig. 52)

a. Lubricate (par. 26) the hobbed surface of the telescope holder and the internal bearing surfaces of the telescope holder housing. Slide the telescope holder assembly into the telescope holder housing.

b. Using a spanner wrench, screw the 1 x 7/16 brass plug into the threaded end of the telescope holder. Tighten the plug. Rotate the holder. There should not be any binding or endplay. If any binding or endplay is present, adjust the plug to remove it. When the proper movement is obtained, screw the No. 8 (0.164) x 5/32 headless set screw into the plug and tighten against the drill point of the holder. If the screw hole and drill point do not aline after adjusting, a new hole must be drilled. With a No. 29 drill, drill the hole 180° from the original hole and drill-point the holder directly under the hole. Tap the hole with a No. 8–36NF–3 tap.

c. Insert the 1/2 x 2 1/4 hex-head cap screw in the telescope holder housing. Slide a 1/2-inch medium lock washer on the cap screw. Screw a 1/2-inch regular hex nut on the cap screw. Tighten the hex nut securely, to clamp the telescope holder assembly.

d. Lubricate (par. 26) the 2 1/8-inch long worm and screw it into the telescope holder housing. Press the 7/8-inch OD brass collar on the protruding end of the worm. Aline the holes for the straight pin. Press or drive in the 3/32 x 7/8 straight pin to secure the collar to the worm. Loosen the clamping screw and rotate the worm with a screwdriver. The movement should be smooth and even without binding or endplay.

167. Installation of the Nameplate
(fig. 52)

Position a serviceable nameplate on the mounting bracket. Press two $\frac{3}{32}$ x $\frac{1}{2}$ button-head rivets in the nameplate and bracket. Rivet and buck the rivets tightly in place to secure the nameplate.

168. Tests and Adjustments

Test and adjustments, other than adjustment of the round nuts and plug, which will be found in paragraphs 163, 165, and 166, will be the same as for the telescope mount M28, paragraph 88.

169. Installation to the On-Carriage Position

Place the telescope mount M46 in position on the carriage. Slide a $\frac{1}{2}$-inch medium lock washer on each of the four $\frac{1}{2}$ x $1\frac{1}{2}$ hex-head cap screws. Insert the cap screws in the mounting bracket and carriage. Screw a $\frac{1}{2}$-inch regular hex nut on each of the four cap screws and tighten securely.

Section IX. TELESCOPE MOUNTS M52C AND M52D

170. General

This section contains the procedure for removal, disassembly, rebuild, assembly, tests and adjustments, and installation of the telescope mounts M52C (fig. 12) and M52D (fig. 13). These telescope mounts are similar to each other, except for the manner and position of their installation.

171. Removal of the Telescope Mount M52C From the On-Carriage Position

a. Remove the hex-head cap screw, hex nut, and lock washer that secure the lower end of the support on a mounting flange attached to gun junction box of the gun.

b. Remove the two hex-head cap screws that secure the mounting bracket brace to the base of the indicator-regulator M1 on the gun. Remove the two spacers from under the brace. Slide the two lock washers from the cap screws.

c. Remove the six hex-head cap screws that secure the lower mounting bracket to the left side of the indicator-regulator. Lift the telescope mount M52C from the carriage. Remove the lock washers from the six cap screws.

172. Removal of the Telescope Mount M52D From the On-Carriage Position

a. Remove the two hex-head cap screws and hex nuts that secure the support bracket to the handwheel gear box of the gun. Slide the lock washers from the cap screws.

b. Remove the two hex-head cap screws that secure the mounting bracket brace to the base of the indicator-regulator. Slide the two spacers from under the brace. Remove the lock washers from the two cap screws.

c. Remove the six hex-head cap screws that secure the lower mounting bracket to the left side of the indicator-regulator. Lift the telescope mount M52D from the carriage. Remove the lock washers from the six screws.

173. Removal of the Mounting Hardware—Telescope Mounts M52C and M52D

a. Suppport (*Telescope Mount M52C Only*) (fig. 56). Remove the hex nut that secures the support to the upper mounting bracket. Remove the lock washer, extract the hex-head cap screw and slide the plain washer from the cap screw.

b. Lower Mounting Bracket (*Telescope Mounts M52C and M52D*) (fig. 57). Remove the four hex nuts and lock washers from the hex-head cap screws that secure the lower mounting bracket to the upper

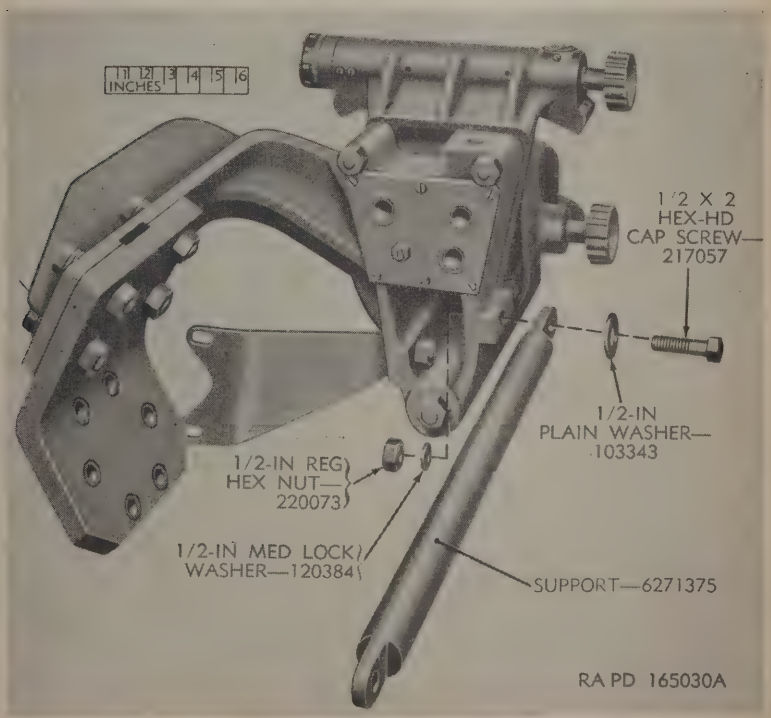

Figure 56. Telescope mount M52C—removal of support.

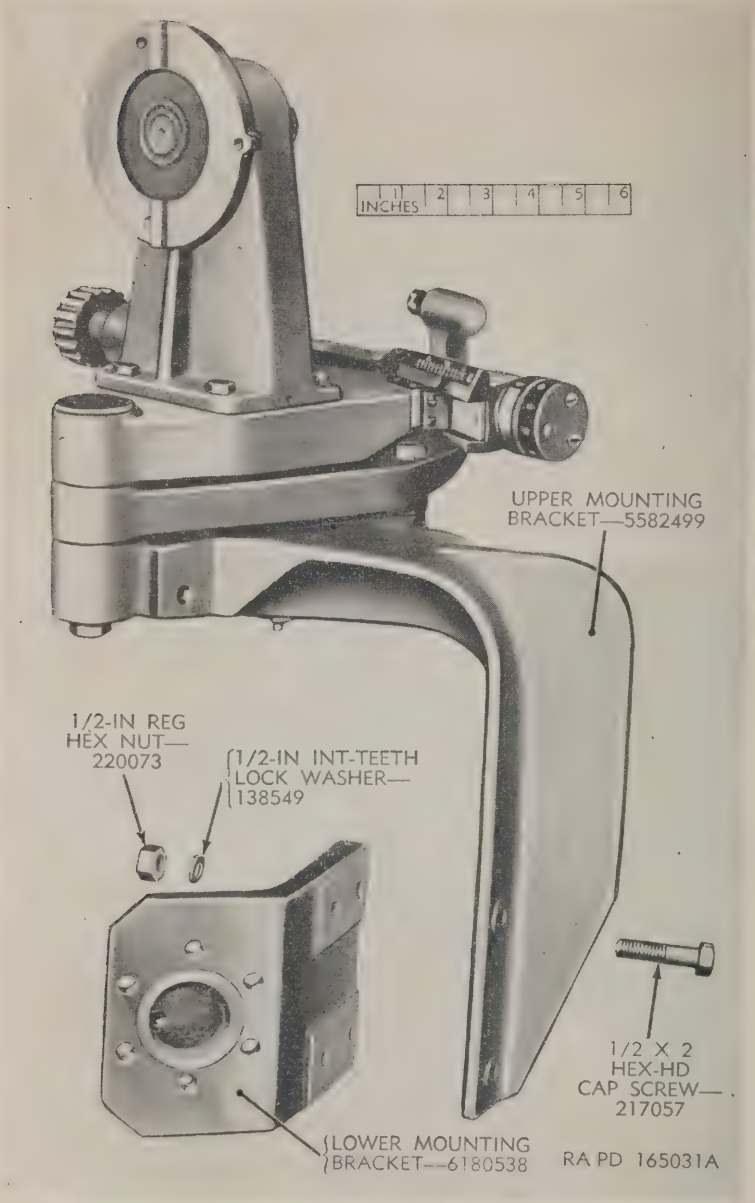

Figure 57. Telescope mounts M52C and M52D—removal of the lower mounting bracket.

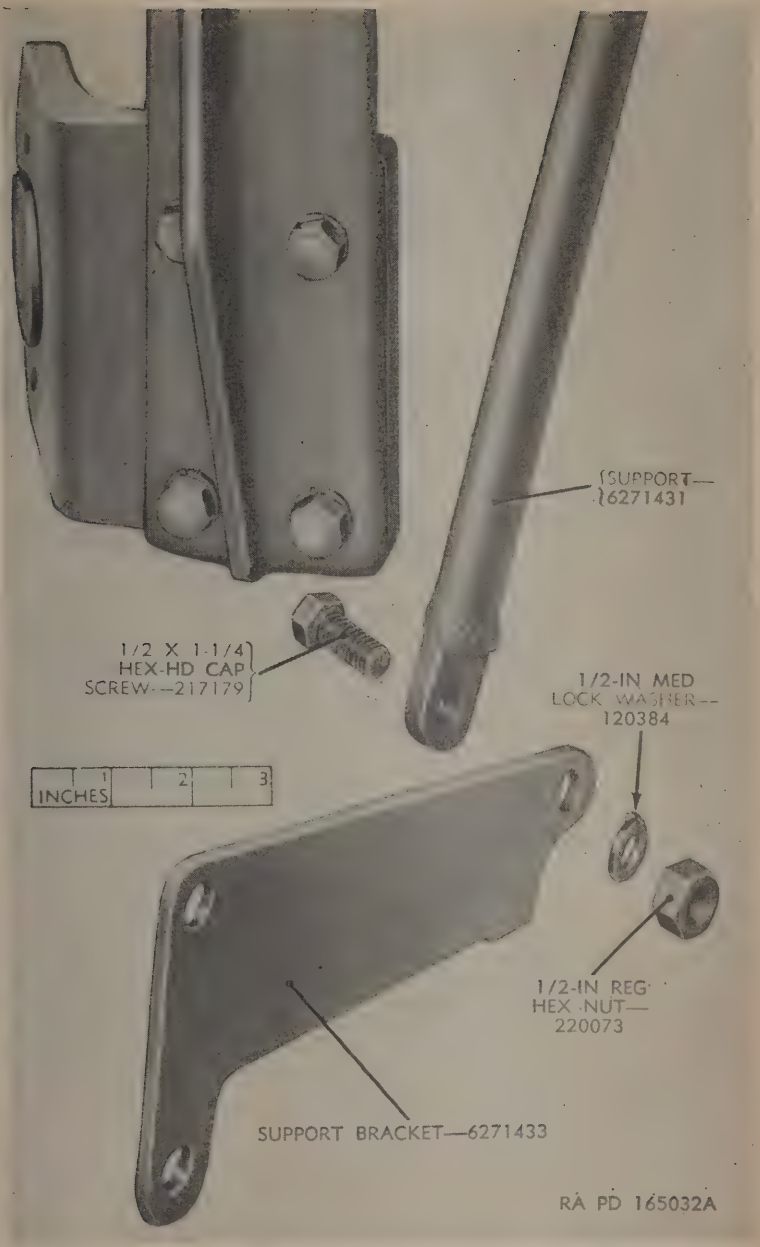

Figure 58. Telescope mount M52D—removal of the support bracket.

mounting bracket. Remove the four hex-head cap screws and separate the lower mounting bracket from the upper mounting bracket.

c. Support Bracket (Telescope Mount M52D Only) (fig. 58). Remove the hex nut and lock washer from the hex-head cap screw that secures the support bracket to the lower end of the support. Remove the hex-head cap screw and separate the bracket from the support.

d. Support (Telescope Mount M52D Only) (fig. 59). Remove the hex-head cap screw that secures the support to the upper mounting bracket. Separate the support from the mounting bracket. Slide the plain washer from the cap screw.

e. Mounting Bracket Brace (Telescope Mounts M52C and M52D) (fig. 60). Remove the hex nut that secures the brace to the right-rear side of the upper mounting bracket. Remove the lock washer from the hex-head cap screw. Extract the cap screw and remove the plain washer from the cap screw.

Note. The remaining disassembly procedures are the same for both telescope mounts M52C and M52D.

174. Removal of the Elevation Worm Housing Assembly and Azimuth Worm Segment Assembly

(fig. 61)

a. Remove the headless set screw in the azimuth worm bracket assembly that locks the azimuth segment pivot pin in the azimuth worm bracket assembly.

b. Press or drive out the straight pin that passes through the azimuth worm bracket and the azimuth segment pivot pin.

c. Remove the jam nut on the lower end of the azimuth segment pivot pin. Slide the internal-teeth lock washer from the end of the pivot pin.

d. Using a wood drift, press the azimuth segment pivot pin from the mounting bracket, azimuth worm bracket, and azimuth worm segment.

Note. The fitting located on the top of the azimuth segment pivot pin will be removed and the hole permanently plugged (par. 26c).

e. Carefully separate the housing assembly and segment from the azimuth worm bracket.

175. Removal of the Elevation Worm Housing Assembly From the Azimuth Worm Segment Assembly

(fig. 62)

Remove the four hex nuts, lock washers, and hex-head cap screws that secure the assemblies together. The hex nuts and lock washers are on the underside of the segment. Pry the housing assembly from the azimuth segment assembly.

Note. Be careful not to damage the two straight pins that position the housing on the segment.

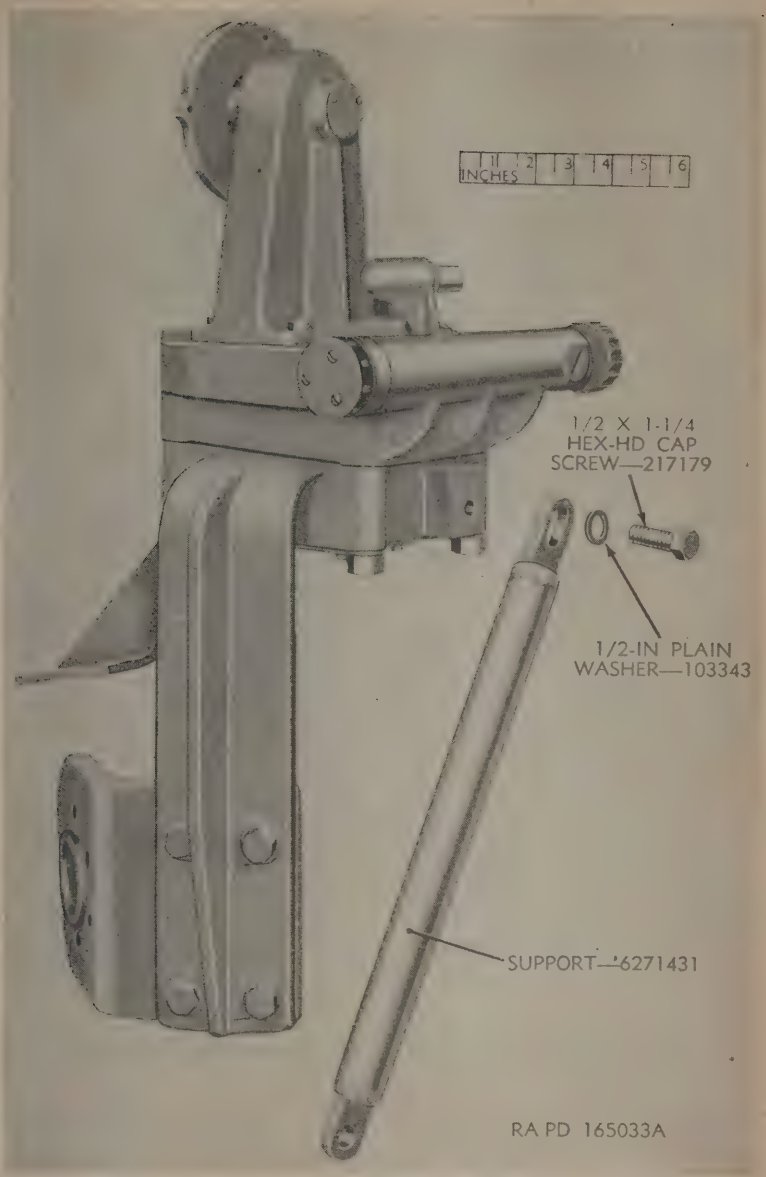

Figure 59. Telescope mount M52D—removal of the support.

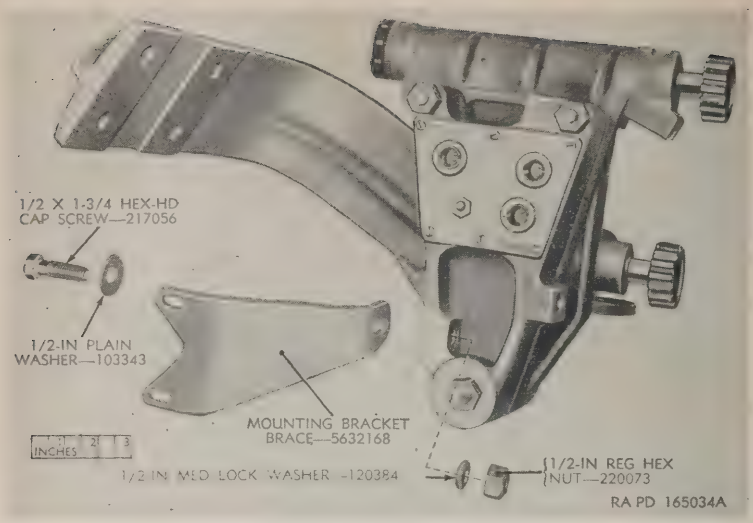

Figure 60. Telescope mounts M52C and M52D—removal of the mounting bracket brace.

176. Removal of the Azimuth Scale Index

(fig. 62)

Remove the two round-head screws and lock washers that secure the azimuth scale index to the azimuth worm segment. Separate the index from the segment.

177. Removal of the Nameplate

(fig. 62)

Note. Do not remove the nameplate unless it is damaged.

Using a sharp chisel, strike off the heads of the two rivets that secure the nameplate to the top side of the azimuth worm segment. Separate the nameplate from the segment. Press the remainder of the rivets from the segment.

178. Removal of the Azimuth Worm Bracket Assembly

(fig. 63)

a. Remove the two hex nuts on the end of the two hex-head cap screws that pass through the azimuth worm bracket assembly and the upper mounting bracket. Slide the lock washers from each of the two cap screws. Extract the two cap screws from the azimuth worm bracket assembly.

b. Separate the azimuth worm bracket assembly from the upper mounting bracket.

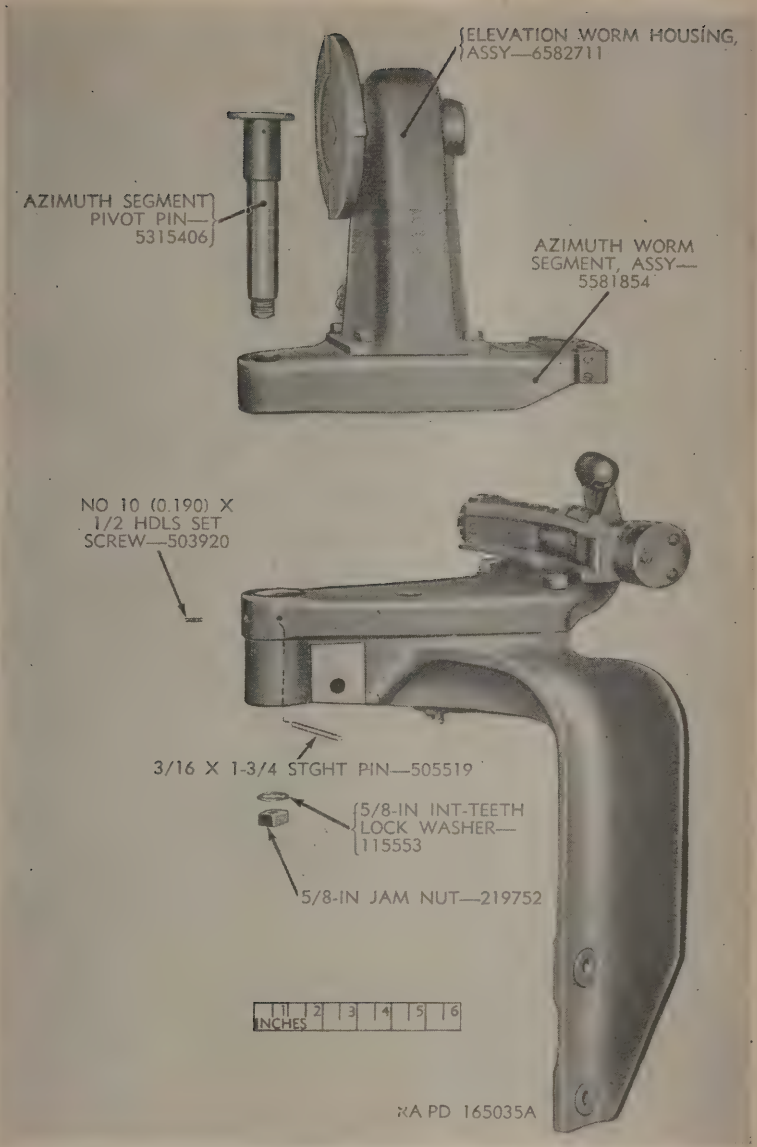

Figure 61. Telescope mounts M52C and M52D—removal of the elevation worm housing assembly and azimuth worm segment assembly—exploded view.

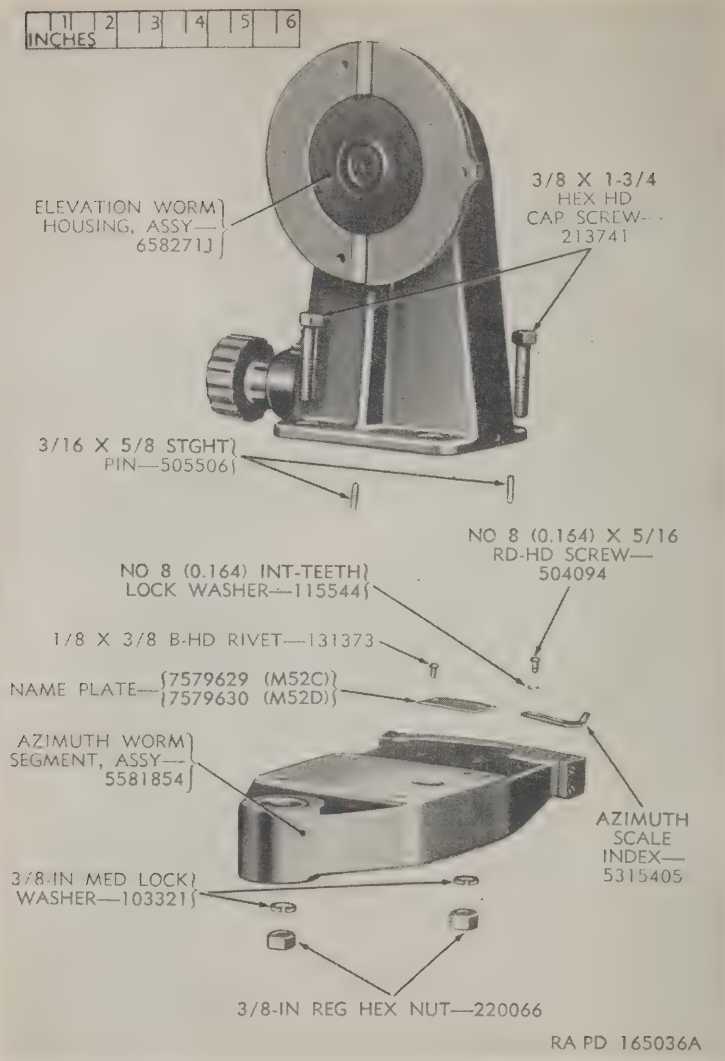

Figure 62. Telescope mounts M52C and M52D—removal of the elevation worm housing assembly from the azimuth worm segment assembly—exploded view.

179. Removal of the Lamp Bracket and Socket Assembly (fig. 63)

Remove the two fillister-head screws that secure the lamp bracket to the azimuth worm bracket assembly. Lift the lamp bracket and socket assembly from the azimuth worm bracket assembly.

180. Removal of the Lighting Switch Cover Assembly (fig. 64)

a. Remove the six fillister-head screws and lock washers that secure the cover assembly to the underside of the upper mounting bracket.

b. Pry the cover assembly from the mounting bracket.

Note. Be careful not to damage the cover gasket.

181. Disassembly of the Elevation Worm Housing Assembly (fig. 65)

a. Removal of the Plunger and Compression Spring.

(1) Remove the headless set screw (R) that locks the brass plug in the underside of the elevation worm housing. Unscrew the plug (U) from the housing.

Note. The plug is under tension from the compression spring.

(2) Extract the compression spring and worm plunger (S) from the elevation worm housing.

b. Removal of the Elevation Worm.

(1) Remove the jam nut (A) that secures the knob on the end of the elevation worm. Pull the lock washer (B), knob (C), and felt washer (D) from the end of the worm.

(2) Unscrew the headless set screw (G) that locks the ball cap in the elevation worm housing. Using the proper size spanner wrench, unscrew the ball cap (E) from the housing and slide it from the worm.

(3) Loosen the headless special screw (H) that locates the ball socket in the housing. Extract the elevation worm (F) and ball socket (W) from the housing. Slide the ball socket from the elevation worm.

c. Removal of the Elevation Worm Segment Assembly and Elevation Worm Segment Spindle.

(1) Remove the three round-head screws (J) and lock washers (K) that secure the elevation worm housing cover to the elevation worm housing. Lift the cover (L) from the housing. Remove the cover gasket (M) from the housing.

(2) Rotate the spindle (Q) so that the hex-head cap screw (clamping) in the segment assembly is accessible. Insert a socket wrench in the underside of housing, engaging the cap screw; loosen the cap screw. Press the elevation worm segment spindle (Q) from the elevation worm housing and the elevation worm segment assembly.

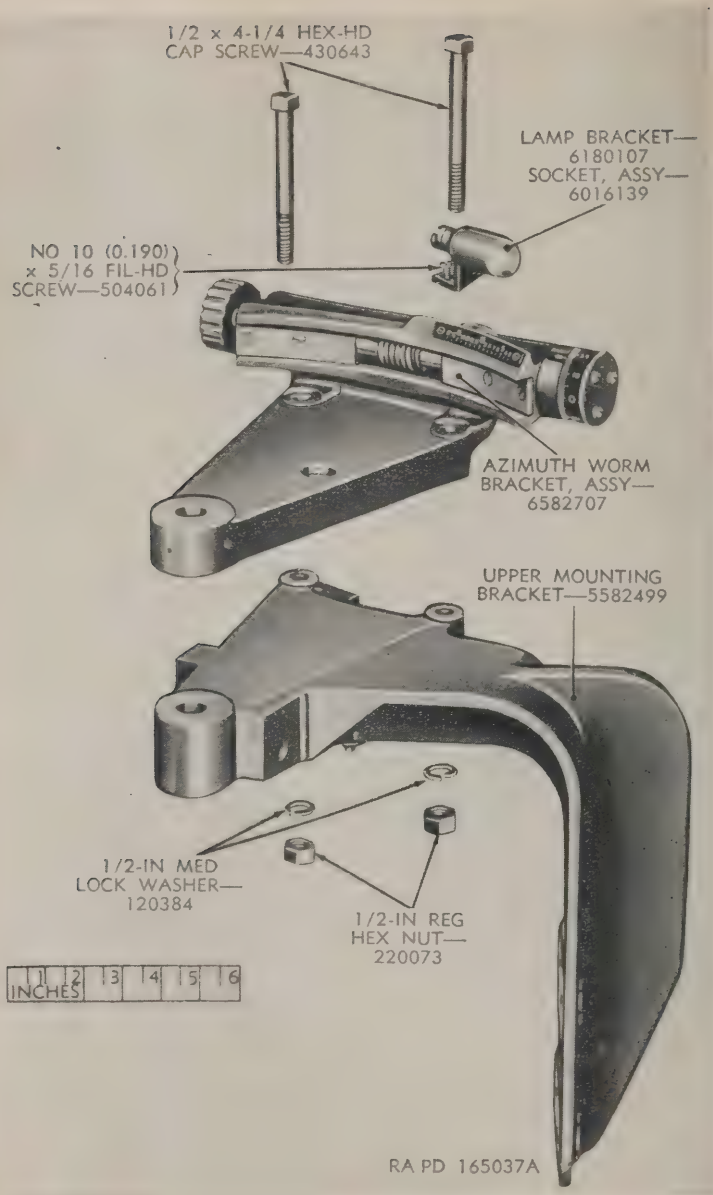

Figure 63. Telescope mounts M32C and M32D—removal of the azimuth worm bracket assembly and related parts—exploded view.

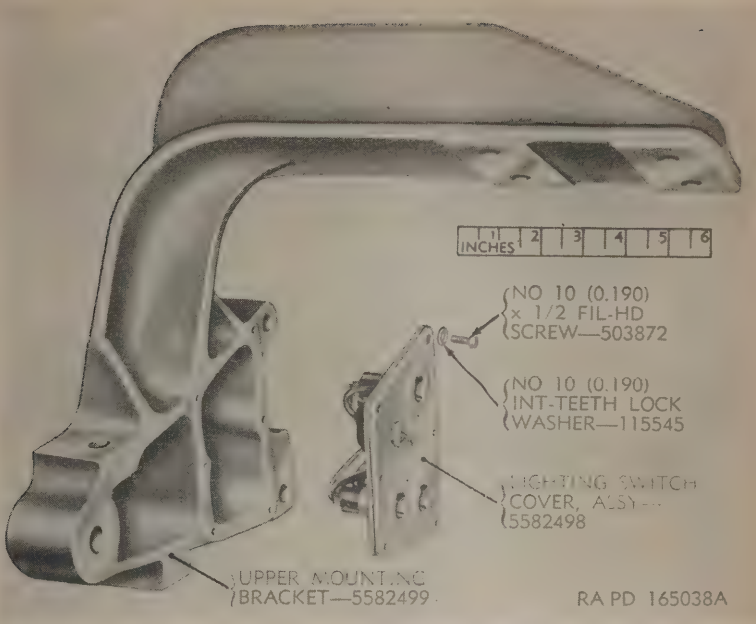

Figure 64. Telescope mounts M52C and M52D—removal of the lighting switch cover assembly—exploded view.

(3) Extract the elevation worm segment assembly (V) from the housing. Pull the felt washer (P) from the groove in the spindle.

182. Disassembly of the Stripped Elevation Worm Housing Assembly

(fig. 66)

a. Press out the three grease fittings from the housing. Unscrew the fourth fitting from the worm housing. Upon rebuild, the fitting holes become plugged permanently (par. 26*c*).

b. If the bushings are worn or damaged, press or drive out the two straight pins that secure the two bushings in the housing.

183. Disassembly of the Elevation Worm Segment Assembly

(fig. 67)

a. Unscrew the hex-head cap screw from the upper end of the elevation worm segment. Slide the lockwasher from the cap screw.

b. Scribe the lines (par. 24*b*) on the stops and the segment. Remove the flat-head screws that secure each of the two stops to the segment. Lift the stops from the elevation worm segment.

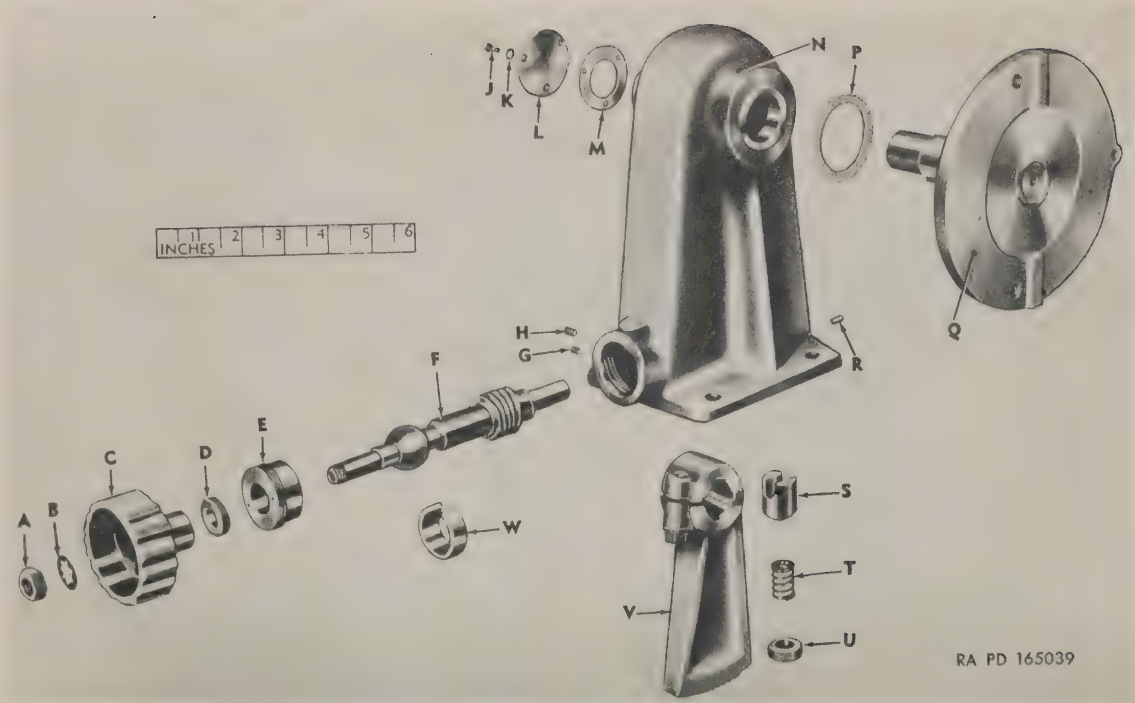

Figure 65. Telescope mounts M52C and M52D—elevation worm housing assembly—exploded view.

A—⅜-in. jam nut—219708
B—⅜-in. int-teeth lock washer—115549
C—2-in. od knob—5315388
D—¾-in. od felt washer—5315389
E—15/16-in. ball cap—5034054
F—Elevation worm—6180109
G—No. 10 (0.190) x 3/16 hdls set screw—503918
H—No. 10 (0.190) x 0.3 overall hdls special screw—5179601
J—No. 5 (0.125) x ⅜ rd-hd screw—504089
K—No. 5 (0.125) int-teeth lock washer—180156
L—Elevation worm housing cover—5315401
M—Cover gasket—5315402
N—Stripped elevation worm housing assy—5581855
P—1⅞-in. od felt washer—5315403
Q—Elevation worm segment spindle—5581858
R—No. 10 (0.190) x ⅜ hdls set screw—540987
S—Worm plunger—5046245
T—0.566-in. od compression spring—5046246
U—⅞ x ¼ br plug—5036245
V—Elevation worm segment assy—5581856
W—15/16-in. ball socket—5032124

Figure 65—Continued

184. Disassembly of the Azimuth Worm Segment Assembly
(fig. 68)

a. Remove the two fillister-head screws that secure the wiper holder, wiper, and the wiper support to each side of the azimuth worm segment. Remove these components.

b. Scribe (par. 24*b*) each of the two cross-level worm stops. Remove the two flat-head screws that secure the stops to the segment. Lift the two stops from the segment.

185. Disassembly of the Stripped Azimuth Worm Segment Assembly
(fig. 68)

Note. Do not remove the bushing unless it is damaged.

Press or drive out the straight pin that secures the bushing in the segment. Press the bushing out of the segment.

186. Disassembly of the Azimuth Worm Bracket Assembly
(fig. 69)

a. Removal of the Azimuth Worm Housing Strips. Remove the four flat-head screws (CC) that secure the two strips to the azimuth worm bracket. Remove the two strips (BB).

b. Removal of the Compression Spring and Plunger. Remove the headless set screw (DD) that locks the plug (spring retaining) (H) in the bracket. Unscrew the plug from the bracket.

Note. The plug is under tension from the compression spring.

Extract the compression spring (G) and worm plunger (F) from the bracket.

c. Removal of the Azimuth Micrometer and Micrometer Adapter. Remove the three round-head screws (V) and lock washers (U) that secure the retaining disk (T) to the micrometer adapter (W). Remove the disk and slide the azimuth micrometer (S) from the micrometer adapter. Properly support the adapter and press or drive out the taper pin (R) that secures the adapter to the worm (L). Pull the micrometer adapter from the worm shaft.

d. Removal of the Azimuth Scale. Remove the two flat-head screws (J) that secure the azimuth scale (K) to the azimuth worm bracket. Lift off the scale.

e. Removal of the Knob. Remove the jam nut (A) that secures the knob to the worm shaft. Slide the lock washer (B) from the worm. Pull the knob (C) and felt washer (D) from the worm shaft.

f. Removal of the Azimuth Worm and Ball Socket. Remove the three round-head screws (X) and lock washers (Y) that secure the adapter spring (Q) to the azimuth worm bracket. Remove the spring.

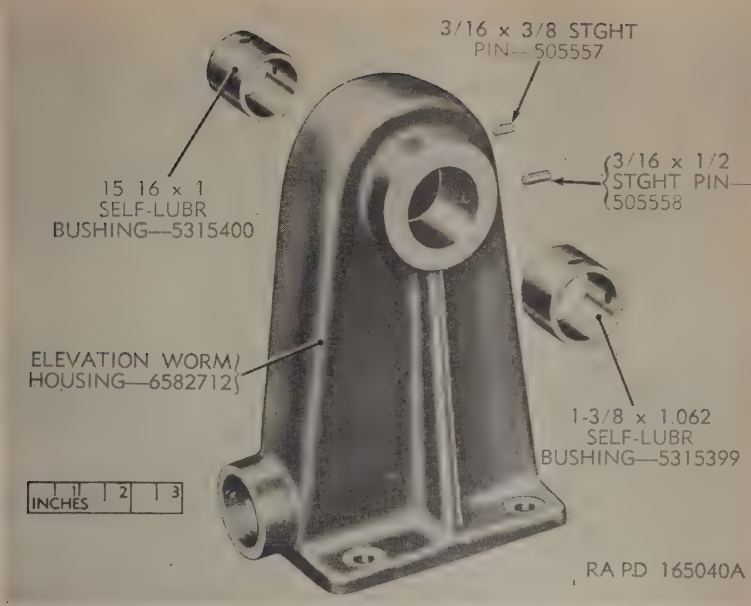

Figure 66. Telescope mounts M52C and M52D—stripped elevation worm housing assembly—exploded view.

Figure 67. Telescope mounts M52C and M52D—elevation worm segment assembly—exploded view.

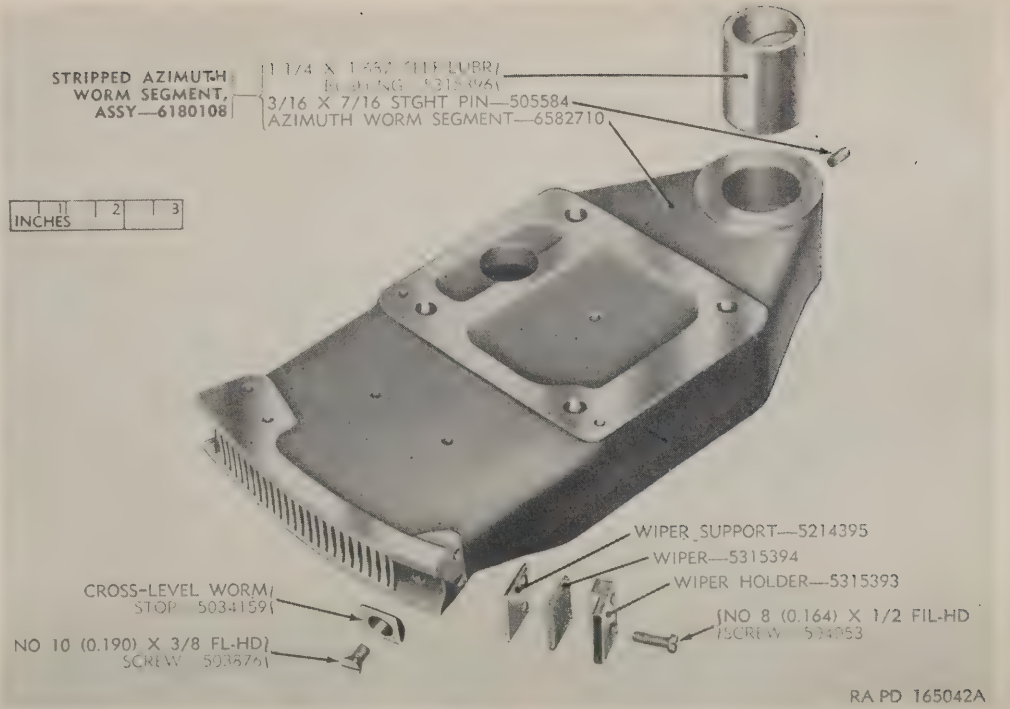

Figure 68. Telescope mounts M52C and M52D—azimuth worm segment assembly—exploded view.

Remove the felt washer (P) from the worm shaft. Remove the headless set screw (Z) that locks the ball cap in the bracket. Using a spanner wrench, unscrew the ball cap (N) from the bracket and slide it from the worm shaft. Loosen the special screw (AA) that positions the ball socket in the bracket. Extract the azimuth worm (L) and ball socket (M) from the azimuth worm bracket. Slide the ball socket from the worm.

Note. The two fittings located on top of the bracket assembly will be removed and the holes permanently plugged (par. 26*c*).

187. Disassembly of the Lighting Switch Cover Assembly (fig. 70)

Note. This assembly should be disassembled only if necessary.

a. Unsolder the wire connections between the sockets and the toggle switch.

b. Unscrew the lock nuts from each of the three double contact sockets and slide the lock washer from the sockets. Slide the three double contact sockets from the lighting switch cover.

c. Remove the lock nut that secures the toggle switch in the cover. Slide the lock washer from the switch and extract the switch from the cover.

d. If the cover gasket has become brittle or damaged, pull it from the cover.

188. Disassembly of the Socket Assembly (fig. 71)

Unscrew the socket assembly with lamp from the lamp bracket. Press the lamp in toward the socket assembly and rotate to the left about one-quarter turn. The lamp will snap out of the socket.

Note. Further disassembly is unnecessary.

189. Rebuild

a. General. All component parts having seating, locating, or bearing surfaces must be free of nicks, burs, or other deformities. On all threaded components, the thread must not be crossed or damaged. It is very important that the in-process inspection be of the highest standards, since final acceptance of the assembled materiel depends largely upon the care exercised during the in-process inspection.

b. Grease and Oil Fittings. All the grease and oil fittings will be removed and permanently plugged (par. 26*c*).

c. Scales and Indexes. All graduations on scales and indexes will be clear and legible.

d. Worms. Repair and rebuild procedure of the elevation and azimuth worms will be found in paragraphs 35 and 36.

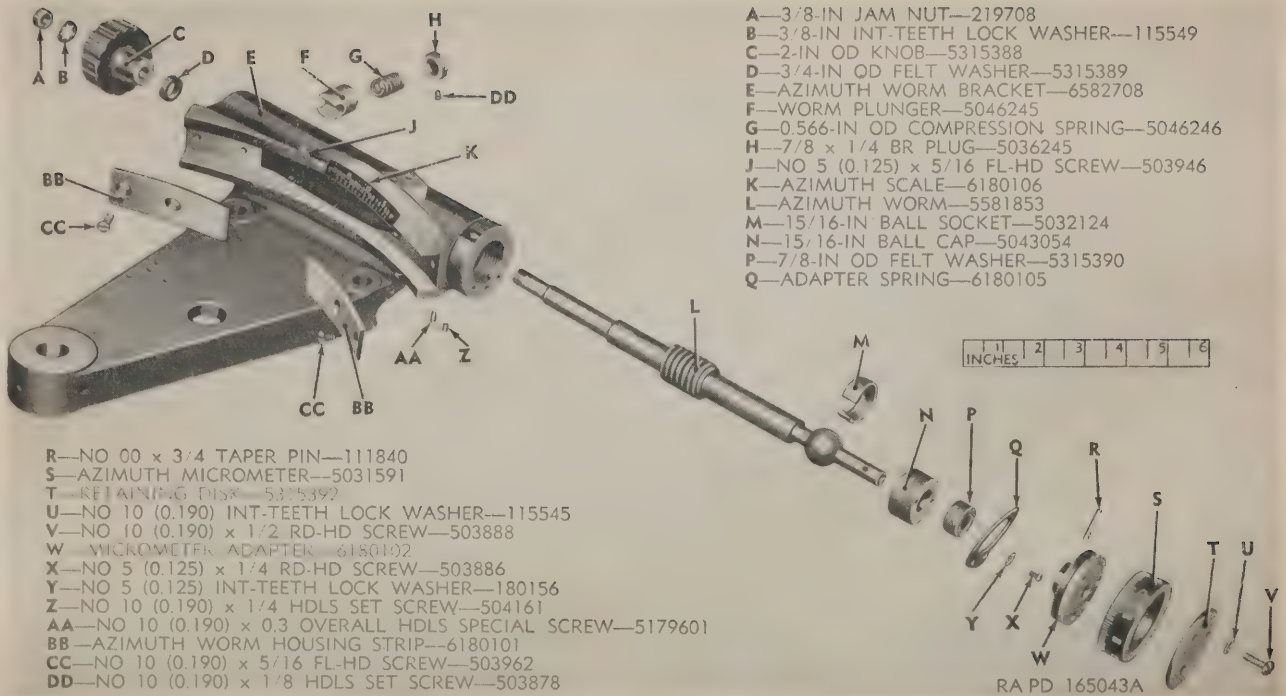

Figure 69. Telescope mounts M52C and M52D—azimuth worm bracket assembly—exploded view.

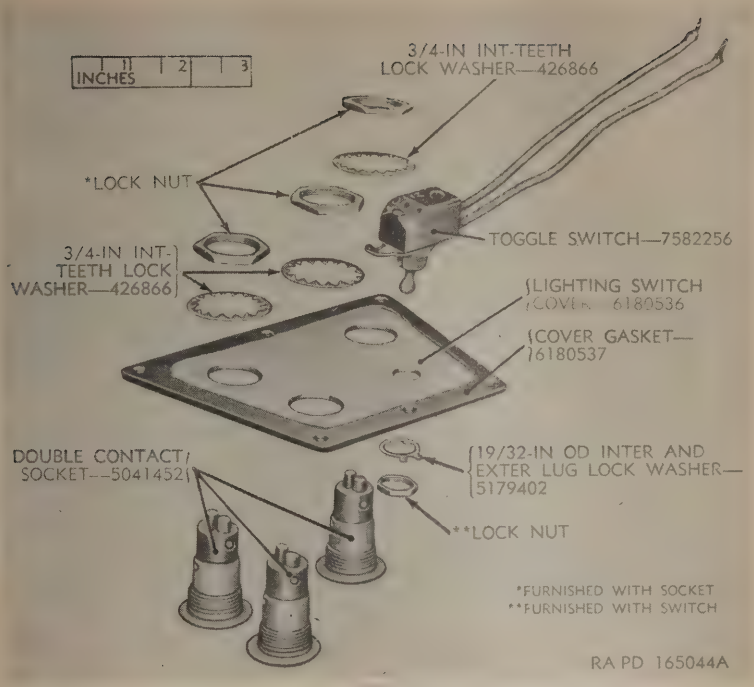

Figure 70. Telescope mounts M52C and M52D—lighting switch cover assembly—exploded view.

c. Ball Caps and Ball Sockets. Repair and rebuild procedure of the ball caps and ball sockets will be found in paragraph 37.

f. Worm Plungers. Rebuild procedure of the worm plungers will be found in paragraphs 38 and 39.

g. Elevation Worm Segment Spindle. Remove all nicks, burs (par. 24*c*), rust, or corrosion (par. 24*d*) from the spindle. The mounting surface for the telescope must be smooth and flat, to afford a good mounting surface for the telescope. The shaft of the spindle must have a smooth finish.

h. Elevation Worm and Azimuth Worm Segment. Clean the hobbed surface of the segments and remove any nicks, burs (par. 24*c*), rust, or corrosion (par. 24*d*).

i. Threaded Components. Chase all threaded components with the proper size thread chaser. If any screw is damaged to the extent that chasing the thread is of no avail, it must be replaced. If the headless special screws are damaged or broken, they must be replaced.

j. Double Contact Sockets. Check the sockets for rust or corrosion and replace if damaged.

k. Springs. The adapter spring (fig. 69) will meet the following

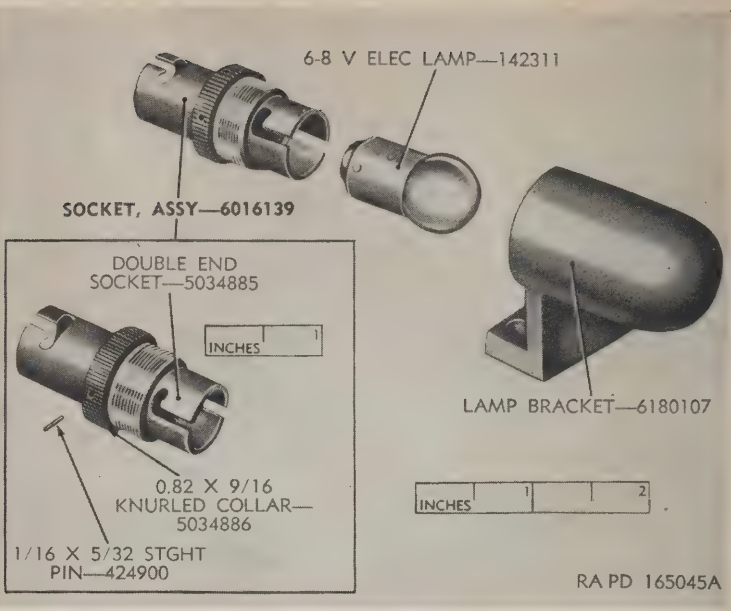

Figure 71. Telescope mounts M52C and M52D—socket assembly and related parts—exploded view.

test for serviceability. Lay the flat portion of the spring, containing the mounting holes upon a flat surface. The raised portion of the spring must measure 0.275 ± 0.010 inch from the surface. Table VI lists the standards for a new compression spring (fig. 69). Replace all springs that are corroded, set, weak, distorted, or fail to meet these standards.

Table VI. Spring Standards

Spring	Part No.	Number of coils	Solid height (in.)	Load at solid height (lb.)	Operating height (in.)	Load at operating height (lb.)
Compression music wire.	5046246	6	0.4062	29 ± 3	0.8125	14.5 ± 1.5

l. Cleaning. Clean all components of the telescope mount as described in paragraph 25.

m. Lubrication. See paragraph 26.

190. Assembly of the Socket
(fig. 71)

Press a serviceable 6- to 8-volt electric lamp in the socket assembly and turn one-quarter turn to the right. Screw the socket assembly with lamp into the lamp bracket and tighten securely.

191. Assembly of the Lighting Switch Cover

a. If the cover gasket (fig. 70) has been removed, replace the gasket and cement to the cover with the proper oil resistant cement (ORD 3 SNL K–1). When the gasket has properly dried, continue with the assembly.

b. Place a serviceable toggle switch (fig. 70) in the smallest of the four holes in the cover. The switch handle must be on the side opposite the gasket. Place a $^{19}/_{32}$-inch OD internal and external lug lockwasher (fig. 70) on the pole end of the switch. Screw the locknut (fig. 70) on the toggle switch and tighten securely.

c. Insert the three double contact sockets (fig. 70) through the front of the cover. Place a $^{3}/_{4}$-inch internal-teeth lockwasher (fig. 70) on each of the sockets and screw on the locknuts. Tighten the locknuts securely.

d. Connect and securely solder the leads from the sockets and switch as indicated in the wiring diagram (fig. 72). Use No. 18 switchboard flexible wire. When finished soldering, clean all traces of soldering flux from the solder leads with alcohol.

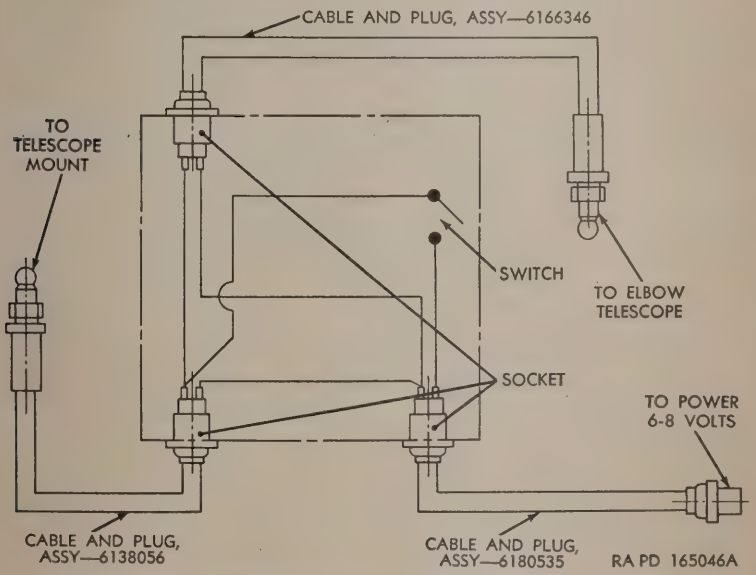

Figure 72.—Telescope mounts M52C and M52D—wiring diagram for lighting switch cover assembly.

192. Assembly of the Azimuth Worm Bracket

Note. The key letters noted in parentheses are in figure 69.

a. Installation of the Azimuth Worm and Ball Socket. Lap the $^{15}/_{16}$-inch ball socket (M) (par. 33) to the azimuth worm (L). When

the ball socket is properly lapped to the worm, lubricate (par. 26) the ball socket and worm. Slide the ball socket on the azimuth worm between the worm ball and worm thread. Insert the azimuth worm and ball socket in the azimuth worm bracket (E). Using a thin piece of wire, position the slot in the socket, so that it is directly under the special screw hole in the bracket. Screw the No. 10 (0.190) x 0.3 overall headless special screw (AA) in the bracket, engaging the dog-point in the slot of the ball socket. Tighten the screw, then back-off slightly. The screw functions as a key from the ball socket and should not be tightened so as to force the ball socket off center. Lubricate (par. 26) the $^{15}/_{16}$-inch ball cap (N) and slide it over the worm shaft.

Note. The ball cap must be lapped to the worm ball (par. 37).

Using a spanner wrench, screw the ball cap into the bracket. Tighten the ball cap, then back off slightly (par. 37). Screw the No. 10 (0.190) x $^1/_4$ headless setscrew (Z) into the bracket, to lock the ball cap; then, tighten the setscrew securely. Saturate the $^7/_8$-inch OD felt washer (P) with oil, then slide the washer on the worm shaft until snug against the ball cap. Position the adapter spring (Q) on the bracket, if it meets the standards in paragraph 189, and secure in place with three No. 5 (0.125) x $^1/_4$ round-head screws (X) and three internal-teeth lockwashers (Y). Tighten the three screws securely.

b. Installation of the Knob. Saturate the $^3/_4$-inch OD felt washer (D) with oil and slide on the worm shaft (opposite end from the worm ball) until snug against the bracket (E). Slide the 2-inch OD knob (C) on the worm, so the key of the knob enters the keyway in the worm shaft. Place a $^3/_8$-inch internal-teeth lockwasher (B) on the shaft and screw a $^3/_8$-inch jam nut (A) on the shaft. Tighten the jam nut securely. Stake (par. 47) the last thread of the worm, to assure that the jam nut does not work loose.

c. Installation of the Compression Spring and Plunger. Properly lap the worm plunger (F) to the worm shaft (pars. 38 and 39). Lubricate (par. 26) the plunger and insert it into the bracket, with the forked end over the worm shaft. Test the 0.556-inch OD compression spring (G) according to the tabulated data in paragraph 189*k*. Lubricate (par. 26) and insert the spring against the worm plunger. Screw the $^7/_8$ x $^1/_4$ brass plug (H) into the bracket and tighten securely.

Note. The plug and plunger will be properly adjusted to the worm shaft as directed in paragraphs 38 and 39.

Screw the No. 10 (0.190) x $^1/_8$ headless setscrew (DD) into the bracket, to lock the plug.

d. Installation of the Azimuth Scale. Position the azimuth scale (K) on the azimuth worm bracket (E) and secure in place with two

No. 5 (0.125 x 5/16 flat-head screws (J). Tighten the screws securely.

e. Installation of the Azimuth Micrometer and Micrometer Adapter. Press the micrometer adapter (W) on the worm shaft, alining the holes for the taper pin. Press or drive in the No. 00 x 3/4 taper pin (R). See paragraph 29 for proper method of installing taper pins. If a new adapter is used, drill and ream the hole for the taper pin.

Note. At the time of requisition, the adapter will have a hole drilled for the taper pin in one side only. The ratchet on the adapter must be in line with the detent on the adapter spring.

Slide the azimuth micrometer (S) on the adapter. Position the retaining disk (T) against the adapter and secure with three No. 10 (0.190) x 1/2 round-head screws (V) and three internal-teeth lockwashers (U). Tighten the screws securely. Using a feeler gage, check the clearance between the bracket and the micrometer. Check at the point opposite to where the adapter spring is secured. The clearance should be 0.03 inch. Remove any necessary amount of the micrometer to reach this tolerance. Check the movement of the worm. Binding, clicking, blacklash, etc., should not be present (pars. 41 through 44).

f. Installation of the Azimuth Worm Housing Strips. Position each of the two strips (BB) in the groove of the azimuth worm bracket (E) and secure each with two No. 10 (0.190) x 5/16 flat-head screws (CC). Tighten the screws securely.

193. Assembly of the Stripped Azimuth Worm Segment (fig. 68)

If the 1 1/4 x 1.687 self-lubricating bushing has been removed, replace the bushing. Press the bushing in the segment and drill and ream the bushing for a 3/16 x 7/16 straight pin. Drive the pin in the segment and bushing.

Caution: The pin must not protrude inside the bushing.

194. Assembly of the Azimuth Worm Segment (fig. 68)

a. Place each of the two cross-level worm stops on the segment, alining the scribe marks and secure each with a No. 10 (0.190) x 3/8 flat-head screw. The stops and screws must be parallel with the end faces of the segment. After the two screws have been securely tightened and staked, lap the screws and stops until they are flush with the face of the segment.

b. Saturate the wiper with oil and position in this order: the wiper support, the wiper, and the wiper holder on each side of the azimuth worm segment; then secure in place with two No. 8 (0.164) x 1/2 fillister-head screws. Tighten the screws securely.

195. Assembly of the Elevation Worm Segment
(fig. 67)

a. Place each of the two stops on the segment, matching the scribe marks. Secure each stop with a No. 10 (0.190) x 3/8 flat-head screw. Tighten the two screws and stake in place. The stops and screws must be flush with the face of the segment. If any high spots are present, remove by lapping (par. 33).

b. Place a 5/16-inch internal-teeth lockwasher on the 5/16 x 1 1/4 hex-head cap screw. Screw the cap screw into the upper end of the elevation worm segment. Do not tighten the cap screw at this time.

196. Assembly of the Stripped Elevation Worm Housing
(fig. 66)

Note. If the bushings have been removed because of damage, replace with serviceable bushings.

Press the 1 3/8 x 1.062 self-lubricating bushing into the large hole in the upper end of the housing. Drill and ream a hole in the bushing, directly in line with the pin hole in the housing, for a 3/16 x 1/2 straight pin. Drive in the 3/16 x 1/2 straight pin. The pin must not protrude inside the bushing. Press the 15/16 OD x 1 self-lubricating bushing in the other hole in the elevation worm housing. Drill and ream a hole in the bushing, in direct line with the pin hole in the housing, for a 3/16 x 3/8 straight pin. Drive in the 3/16 x 3/8 straight pin. The pin must not protrude inside the bushing. Check the bushings, to be sure that they are not loose in the elevation worm housing. The bushings must be flush with the housing.

197. Assembly of the Elevation Worm Housing

Note. The key letters noted in parentheses are in figure 65.

a. Installation of the Elevation Worm Segment Assembly and Elevation Worm Segment Spindle.

Note. The four grease fitting holes in the housing must be permanently plugged (par. 26*c*).

(1) Saturate the 1 7/8-inch OD felt washer (P) with oil; then, place the washer in the groove in the elevation worm segment spindle (Q).

(2) Lubricate (par. 26) the bearing surfaces of the spindle (Q) and the hobbed surface of the segment assembly. Insert the segment assembly (V) in the housing. Insert the spindle into the housing and segment assembly. When the spindle is in its proper place, tighten the clamping cap screw on the segment assembly.

(3) Position a serviceable cover gasket (M) and the elevation worm housing cover (L) on the housing opposite to the

spindle and secure in place with three No. 5 (0.125) x 3/8 round-head screws (J) and three internal-teeth lockwashers (K). Tighten the three screws securely.

b. Installation of the Elevation Worm.

(1) Lubricate (par. 26) the elevation worm (F) and 15/16-inch ball socket (W).

Note. The ball socket must be lapped to the worm ball (par. 37).

Slide the ball socket on the worm between the worm thread and worm ball. Insert the elevation worm and ball socket into the elevation worm housing.

(2) Position the slot in the ball socket under the hole in the housing for the special screw. This can be accomplished with a thin wire. Screw the No. 10 (0.190) x 0.3 overall headless special screw (H) into the housing, engaging the dog point in the slot of the ball socket. Tighten the screw against the slot, then unscrew slightly to relieve the ball socket. The special screw functions as a key for the ball socket and should not be tightened so as to force the ball socket off center.

(3) Lubricate (par. 26) the 15/16-inch ball cap (E), slide it over the worm shaft, and, using a spanner wrench, screw the ball cap into the elevation worm housing. Tighten the ball cap against the worm ball; then loosen it three-quarters of a turn.

Note. For proper function of the ball cap, it must be lapped to the worm ball (par. 37).

Screw the No. 10 (0.190) x 3/16 headless set screw (G) into the housing and tighten against the ball cap.

(4) Saturate the 3/4-inch OD felt washer (D) with oil and slide it on the worm shaft until it is snug against the ball cap. Slide the 2-inch OD knob (C) on the worm shaft. The key in the knob must enter the keyway in the worm shaft. Slide a 3/8-inch internal-teeth lockwasher (B) on the worm and screw a 3/8-inch jam nut (A) on the worm. Tighten the jam nut and, when securely tightened, stake (par. 47) the last thread on the worm shaft.

c. Installation of the Plunger and Compression Spring. Lap (pars. 38 and 39) the worm plunger (S) to the worm shaft. Lubricate (par. 26) and insert the plunger into the housing, with the forked end of the plunger over the worm shaft. Test the 0.566-inch OD compression spring (T) against the tabulated data in paragraph 189*k*. Lubricate (par. 26) and insert the compression spring in the worm plunger. Screw the 7/8 x 1/4 brass plug (U) into the housing, to retain the spring. Screw the No. 10 (0.190) x 3/8 headless setscrew (R) into the housing and tighten against the plug.

198. Installation of the Lighting Switch Cover Assembly (fig. 64)

Position the lighting switch cover assembly in the underside of the upper mounting bracket and secure in position with six No. 10 (0.190) x ½ fillister-head screws and six internal-teeth lockwashers. Tighten the six screws securely.

199. Installation of the Lamp Bracket and Socket Assembly (fig. 63)

Position the lamp bracket and socket assembly on the azimuth worm bracket assembly, so that the illumination will fall on the azimuth scale, and secure in place with two No. 10 (0.190) x 5/16 fillister-head screws. Stake (par. 47) the two screws in place.

200. Installation of the Azimuth Worm Bracket Assembly

a. Position the azimuth worm bracket assembly (fig. 63) on the upper mounting bracket and temporarily install the azimuth segment pivot pin (fig. 61).

b. Insert, through the top of the azimuth worm bracket, two ½ x 4¼ hex-head cap screws (fig. 63). Slide a ½-inch medium lockwasher (fig. 63) on each of the two cap screws. Screw a ½-inch regular hex nut (fig. 63) on each of the two cap screws. Tighten the screws and nuts securely. Remove the azimuth segment pivot pin.

201. Installation of the Nameplate (fig. 62)

Position a serviceable nameplate on the azimuth worm segment assembly. Insert two ⅛ x ⅜ button-head rivets through the plate and segment. Buck and rivet the two rivets to secure the nameplate.

202. Installation of the Azimuth Scale Index (fig. 62)

Position the azimuth scale index on the azimuth worm segment assembly and secure in place with two No. 8 (0.164) x 5/16 round-head screws and two internal-teeth lockwashers. Tighten the two screws securely.

203. Installation of the Elevation Worm Housing Assembly on the Azimuth Worm Segment Assembly (fig. 62)

a. Position the elevation worm housing assembly on the azimuth worm segment assembly. Press or drive in the two 3/16 x ⅝ straight pins that position the housing on the segment.

b. Insert, through the housing and into the segment, four ⅜ x 1¾ hex-head cap screws. Slide a ⅜-inch medium lockwasher on each of the four screws and screw a regular hex nut on each of the four screws. Tighten the four screws securely.

204. Installation of the Elevation Worm Housing Assembly and Azimuth Worm Segment Assembly

(fig. 61)

a. Lubricate (par. 26) the hobbed surface of the segment. Position the segment assembly on the azimuth worm bracket assembly. Be sure the thread of the worm is properly engaged with the hobbed surface of the segment. Lubricate (par. 26) the azimuth segment pivot pin. Aline the pivot pin hole in the segment with the hole in the worm bracket and upper mounting bracket. Slide the pivot pin down into the segment and through the worm bracket and mounting bracket. Screw the No. 10 (0.190) x ½ headless setscrew which positions the pivot pin, into the azimuth worm bracket. Aline the pin hole in the pivot pin with the pin hole in the worm bracket. Tighten the headless setscrew in the bracket to retain this position. Press or drive in a 3/16 x 1¾ straight pin. Place a ⅝-inch internal-teeth lockwasher on the lower end of the pivot pin. Screw a ⅝-inch jam nut on the lower end of the pivot pin and tighten.

b. Rotate the azimuth worm knob, thereby imparting movement to the azimuth worm segment. This movement must be smooth and even without binding or end play between the segment and pivot pin. To adjust, press out the straight pin that secures the pivot pin in the azimuth worm bracket. Loosen the hex jam nut on the lower end of the pivot pin. Loosen the headless setscrew that positions the pivot pin. Position the pivot pin (up or down). Tighten or loosen the jam nut on the lower end of the pivot pin. Tighten the setscrew in the worm bracket. Rotate the azimuth worm knob, to check the movement. It may be necessary to repeat this procedure several times until the desired movement of the segment is obtained. When the adjustment is complete, a hole will have to be drilled and reamed in the pivot pin to accommodate the 3/16-inch straight pin. This will also be necessary, if a new pivot pin is used. The headless setscrew is used to hold the pivot pin in proper adjustment, while drilling and reaming the pin hole.

205. Installation of the Mounting Hardware — Telescope Mounts M52C and M52D

a. Lower Mounting Bracket (*Telescope Mounts M52C and M52D*) (fig. 57). Position the lower mounting bracket on the lower end of the upper mounting bracket and secure in position with four ½ x 2 hex-head cap screws, four internal-teeth lockwashers, and four regular hex nuts. Tighten the screws and nuts securely.

b. Mounting Bracket Brace (*Telescope Mounts M52C and M52D*) (fig. 60). Position the brace on the side of the upper mounting bracket. Place a ½-inch plain washer on the ½ x 1¾ hex-head cap screw. Insert the cap screw in the brace and upper mounting bracket

and slide a ½-inch medium lockwasher on the cap screw. Screw a ½-inch regular hex nut on the cap screw and tighten the screw and nut securely.

c. Support (Telescope Mount M52D Only) (fig. 59). Position the support on the front of the upper mounting bracket. Place a ½-inch plain washer on the ½ x 1¼ hex-head cap screw. Insert the screw in the support and screw securely into the upper mounting bracket and tighten securely.

d. Support Bracket (Telescope Mount M52D Only) (fig. 58). Position the support bracket on the lower end of the support. Place a ½ x 1¼ hex-head cap screw through the support and support bracket. Slide a ½-inch medium lockwasher on the cap screw. Screw a ½-inch regular hex nut on the cap screw and tighten the cap screw and hex nut securely.

e. Support (Telescope Mount M52C Only) (fig. 56). Position the support on the left rear side of the upper mounting bracket. Place a ½-inch plain washer on the ½ x 2 hex-head cap screw and insert the cap screw through the support and upper mounting bracket. Slide a ½-inch medium lockwasher on the cap screw. Screw a ½-inch regular hex nut on the cap screw and tighten the screw and nut securely.

206. Tests and Adjustments

a. Set up for Tests and Adjustments.

(1) Secure the telescope mount on a vertical surface that has been leveled in all planes. When the telescope mount is secured, check the level of the mount with a gunners quadrant.

(2) Mount an elbow telescope M6A1 in position to the elevation worm segment spindle. With the azimuth scale index on "10" (0 deflection) and the azimuth micrometer on "0", the line of sight of the telescope will form a 60° angle with the mounting surface. Set up a suitably alined target, so the mount can be checked up to 7° either side of "10" (0 deflection).

b. Adjustment of the Azimuth Scale Index and Micrometer. If the azimuth scale index and micrometer do not aline at "10" (0 deflection) as in *a* (2) above, adjust the components in the manner described in (1) and (2) below.

(1) *Azimuth scale index.* Loosen the two round-head screws that secure the index to the azimuth worm segment. Slip the index in the elongated holes until the pointer is directly on the "10" (0 deflection) graduation. Tighten the two round-head screws.

(2) *Azimuth micrometer.* Loosen the three round-head screws that secure the retaining disk to the micrometer adapted. Slip the azimuth micrometer to "0" with the index on the azimuth worm bracket. Tighten the three screws. The azi-

muth index will coincide with one of the graduations on the azimuth scale, when the micrometer is on the "0" graduation.

c. Test of Azimuth Movement. Rotate the azimuth worm knob. There must be 7° of movement on either side of the "10" (0 graduation). The azimuth scale is divided into 14 graduations. Each graduation equals 2°. Error in any azimuth reading will not exceed ±0.02°. Check for accuracy of azimuth readings at not less than five different settings.

d. Test of Elevation Movement. The elevation mechanism will move freely without undue binding or looseness. Rotate the elevation worm knob through its full travel. Adjust the ball cap and ball socket as directed in paragraph 37. The worm plunger can be adjusted (pars. 38 and 39) by inserting a screwdriver up through the azimuth worm bracket and segment and tightening or loosening the spring retaining plug.

e. Test and Adjustment for Backlash.

(1) Backlash between the elevation worm and segment will not exceed ±0.088-inch movement on the periphery of the elevation knob.

(2) Backlash between the azimuth worm and segment will not exceed ±0.01°.

(3) Test for backlash as directed in paragraph 19. Adjust backlash as directed in paragraph 41.

f. Test of the Detent Action. When the azimuth worm knob is rotated, the combination of the adapter spring and the micrometer adapter will impart a detent action to the movement of the azimuth worm. Rotate the azimuth worm knob; the spring must be strong enough to snap into the detent of each of the 100 positions, but the azimuth worm must turn when medium pressure is applied to the azimuth knob. Any discrepancy in the spring will warrant its replacement (par. 45). See paragraph 189*k* for standards of spring serviceability.

g. Test of the Lighting Equipment. Check the continuity of the lighting equipment. Connect a 6-volt power source to the power supply socket. Connect a cable from the socket in the cover assembly to the socket assembly in the lamp bracket. With the toggle switch in the OFF position, the lamp in the lamp bracket must not be lighted. When the toggle switch is turned to the ON position, the lamp must light.

h. Adjustment of the Ball Caps and Sockets. See paragraph 37.

i. Adjustment of the Worm Plunger. See paragraphs 38 and 39.

j. Sealing. After all test and adjustments have been made and the telescope mount is functioning properly, the setscrew holes must be sealed. Plug all holes with the proper sealing and plugging cement (ORD 3 SNL K–1).

207. Installation of the Telescope Mount M52D to the On-Carriage Position

a. Position the mount in its on-carriage position. Slide six ½-inch internal-teeth lockwashers on the six ½ x 1¼ hex-head cap screws. Insert the six screws in the lower mounting bracket and screw them into the left side of the indicator-regulator. Screw the cap screws up snugly but do not tighten securely as yet.

b. Place a 0.406 ID x 0.718 OD x $^3/_{64}$ thick spacer under each of the two holes in the mounting bracket brace. Place a ⅜-inch plain washer on each of the two ⅜ x 1¾ hex-head cap screws. Insert the two screws through the mounting bracket brace and spacers and screw them into the base of the indicator-regulator. Do not tighten these screws at this time.

c. Position the support bracket on the end of the support to the handwheel gear box of the gun. Insert the ½ x 1 hex-head cap screws in the support bracket and through the carriage screw hole. Place a ½-inch medium lockwasher on each of the two cap screws. Screw a ½-inch regular hex nut on each of the two cap screws. Tighten all the cap screws and hex nuts, working in opposite pairs.

208. Installation of the Telescope Mount M52C to the On-Carriage Position

a. Position the mount in its on-carriage position. Slide six ½-inch internal-teeth lockwashers on the six ½ x 1¼ hex-head cap screws. Insert the six screws in the lower mounting bracket and screw them into the left side of the indicator-regulator. Screw the cap screws up until snug but do not tighten at this time.

b. Place a 0.406 ID x 0.718 OD x $^3/_{64}$ thick spacer under each of the two holes in the mounting bracket brace. Place a ⅜-inch plain washer on each of the two ⅜ x 1¾ hex-head cap screws. Insert the two screws through the mounting bracket brace and spacer and screw them into the base of the indicator-regulator but do not tighten at this time.

c. Insert the ½ x 1¾ hex-head cap screw through the support and into the carriage. Slide a ½-inch medium lockwasher on the cap screw and screw a ½-inch regular hex nut on the cap screw. Tighten all cap screws and hex nuts securely, working opposite screws until they are all tight.

Section X. TELESCOPE MOUNT M54

209. General

This section contains the procedure for removal, disassembly, rebuild, assembly, tests and adjustments, and installation of the telescope mount M54 (fig. 9).

210. Removal From the On-Carriage Position

Remove the four hex-head cap screws that secure, by means of the mounting bracket, the telescope mount M54 on the right side of the gun cradle, back of the indicator-regulator. Lift the telescope mount from the on-carriage position. Slide the four lockwashers from the four cap screws.

211. Removal of the Instrument Light Clamp Assembly (fig. 73)

Unscrew the two fillister-head screws that secure the instrument light clamp assembly to the spindle extension. Remove the instrument light clamp assembly from the extension. Slide the two lockwashers from the two fillister-head screws.

212. Removal of the Nameplate (fig. 73)

Note. Remove the nameplate only if necessary.

Using a sharp chisel, strike off the ends of the two rivets that secure the nameplate to the mounting bracket. Remove the nameplate and the two rivets.

213. Removal of the Holder Assembly (fig. 74)

Press or drive out the taper pin (par. 30) that secures the holder assembly in the spindle arm.

Note. The taper pin is staked on both ends.

Unscrew the holder assembly from the spindle arm.

214. Removal of the Spindle Assembly (fig. 75)

a. Properly support the collar on the end of the worm in the mounting bracket. Press or drive out the straight pin that secures the collar to the end of the worm. Pull the collar from the worm. Using a screwdriver, unscrew the worm from the mounting bracket.

b. Remove the headless setscrew that locks the round nut on the lower end of the spindle. Using a spanner wrench, unscrew the round nut from the end of the spindle.

c. Remove the two hex nuts on the end of the two hex-head cap screws (clamping) in the mounting bracket. Slide the lockwashers from the cap screws, and remove the cap screws from the mounting bracket.

d. Slide the spindle assembly out of the mounting bracket.

Note. Use care so as not to damage the machined surface of the spindle.

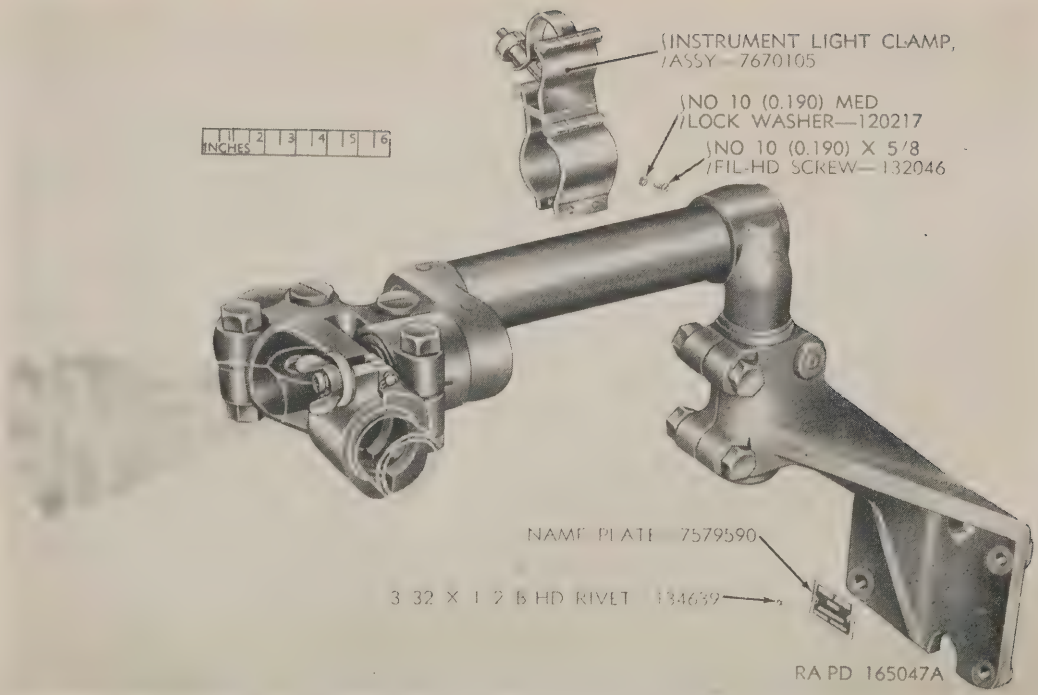

Figure 73. Telescope mount M54—removal of the instrument light clamp assembly and nameplate.

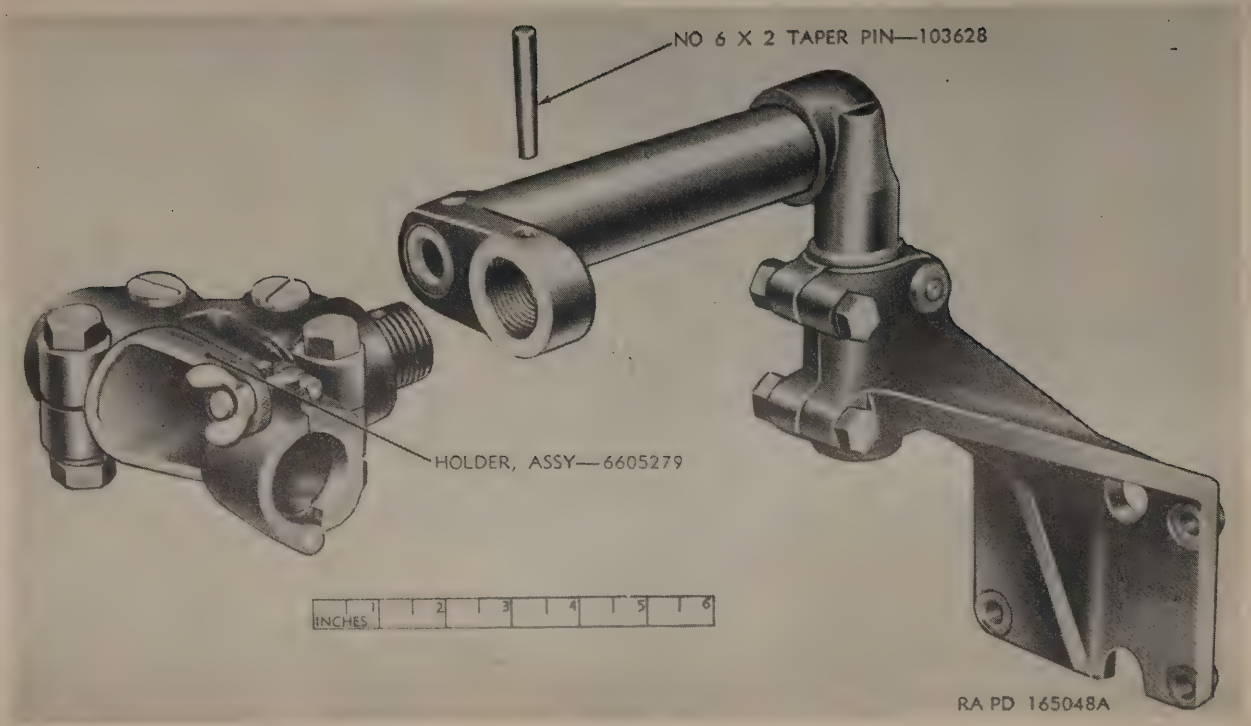

Figure 74. Telescope mount M54—removal of the holder assembly—exploded view.

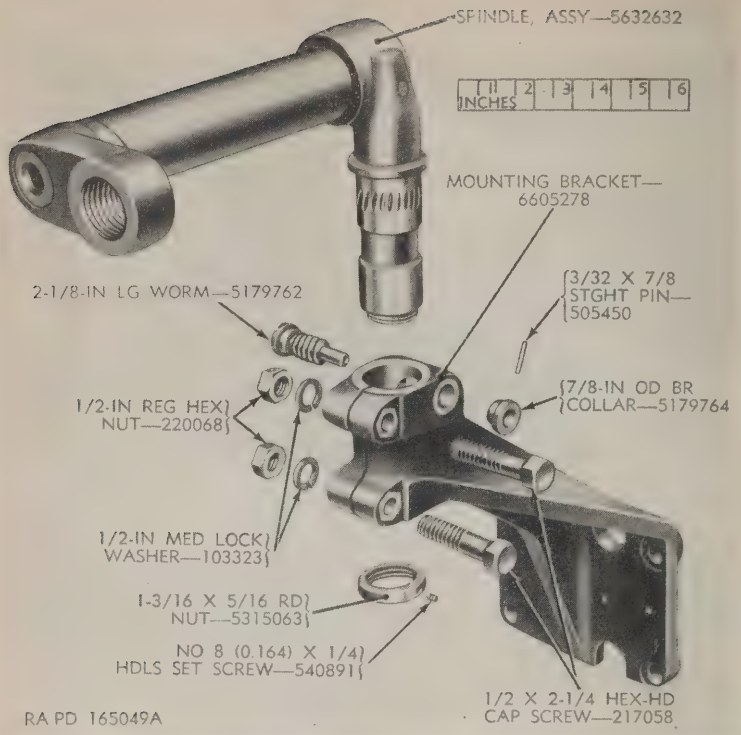

Figure 75. Telescope mount M54—removal of the spindle assembly and related parts—exploded view.

215. Disassembly of the Instrument Light Clamp Assembly

This assembly is of riveted and spun construction. It should not be disassembled.

216. Disassembly of the Holder Assembly

(fig. 76)

a. Press or drive out the straight pin that secures one of the collars to the worm. Pull the collar from the worm. Using a screwdriver, unscrew the worm from the telescope holder housing. The other worm will be removed in the same manner.

b. Remove the headless setscrew that locks the plug in the telescope holder assembly. Using a spanner wrench, unscrew the plug from the telescope holder. Unscrew the hex nut on the end of the hex-head cap screw that clamps the telescope holder assembly in the telescope holder housing. Slide the lockwasher from the cap screw and extract the cap screw from the housing. Carefully slide the telescope holder assembly from the telescope housing.

c. Remove the headless setscrew that locks the round nut on the end of the elevation adjustment worm gear, opposite to where the taper pin enters. Using a spanner wrench, unscrew the round nut from the worm gear. Unscrew the hex nut on the end of the hex-head cap screw that clamps the elevation adjustment worm gear in the telescope holder housing. Slide the lockwasher from the cap screw and extract the cap screw from the telescope holder housing. Slide the elevation adjustment worm gear from the telescope holder housing.

d. Press the two oilcups from the top of the telescope holder housing. The oilcups will be permanently removed and the holes plugged (par. 26*c*).

217. Disassembly of the Telescope Holder Assembly

For disassembly of the telescope holder assembly, which is identical to the telescope holder assembly on the telescope mount M28 (fig. 35), see paragraph 72.

218. Disassembly of the Spindle Assembly (fig. 77)

a. Properly support the spindle arm and press or drive out the taper pin (par. 30) that secures the spindle arm to the spindle extension. Pull the spindle arm from the spindle extension.

b. Support the spindle and press or drive out the taper pin (par. 30) that secures the spindle to the spindle extension. Pull the spindle from the spindle extension.

219. Rebuild

a. General. All component parts having seating, locating, or bearing surfaces must be free of nicks, burs, or other deformities. On all threaded components, the threads must not be crossed or damaged. It is very important that the in-process inspection be of the highest standards, since final acceptance of the assembled materiel depends largely upon the care exercised during the in-process inspection.

b. Oilcups. The two oilcups in the telescope holder housing will be removed and the holes permanently plugged (par. 26*c*). Be sure that after plugging, the plugs do not protrude inside the housing.

c. Nameplate. The lettering on the nameplate must be clear and distinct.

d. Telescope Holder Housing. The internal machined surfaces of the housing must have a smooth finish. Remove all nicks or burs (par. 24*c*) and rust or corrosion (par. 24*d*).

e. Elevation Adjustment Worm Gear. Chase the threaded surface of the gear with the proper size thread chaser. Clean the hobbed surface and remove any nicks or burs (par. 24*c*) and rust or corrosion (par. 24*d*).

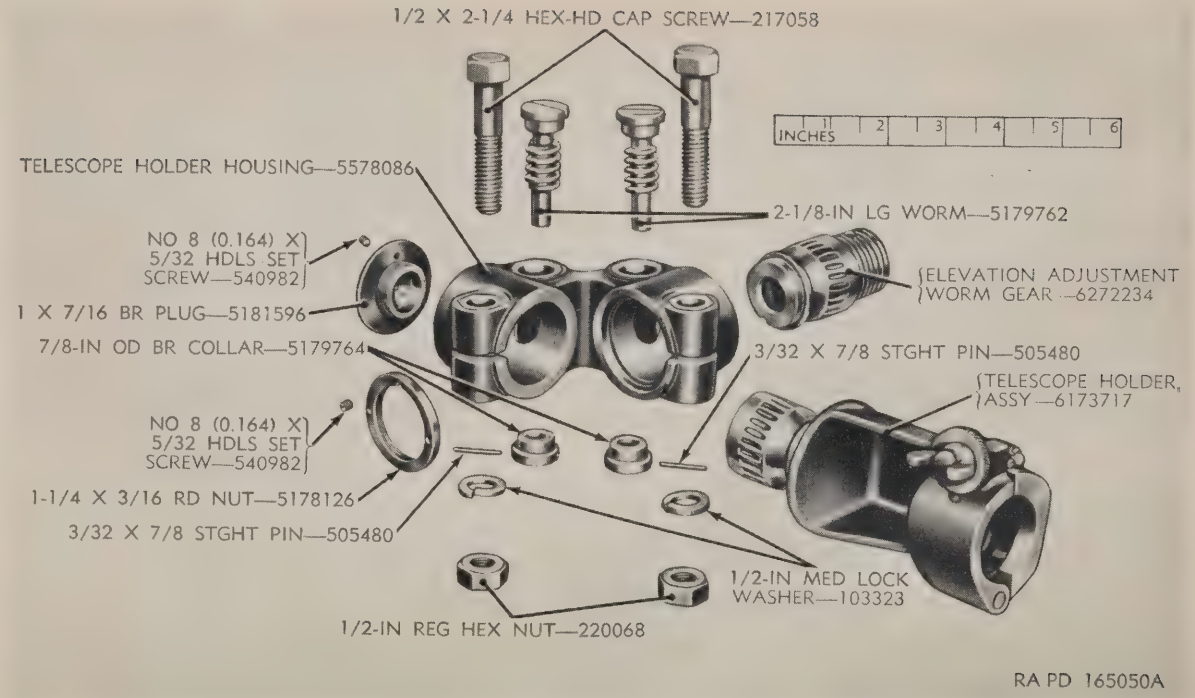

Figure 76. Telescope mount M54—holder assembly—exploded view.

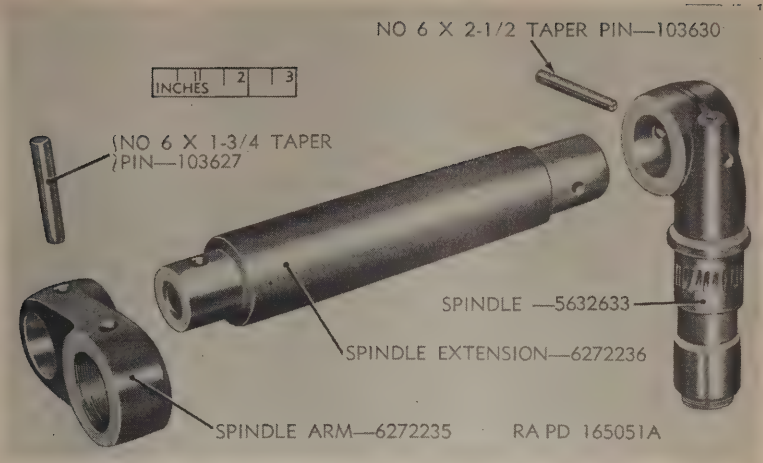

Figure 77. Telescope mount M54—spindle assembly—exploded view.

f. Spindle Extension. The spindle extension must be straight and free of nicks or burs (par. 24*c*) and rust or corrosion (par. 24*d*).

g. Spindle. Chase the threaded surface of the spindle with the proper size thread chaser. Clean the hobbed surface of the spindle and the hole used for the insertion of the spindle extension. Remove all nicks or burs (par. 24*c*) and rust or corrosion (par. 24*d*).

h. Threaded Components. Chase all threaded components with the proper size thread chaser. If the thread is too badly damaged, replace the components.

i. Instrument Light Clamp Assembly. Nicks or bends in this assembly may be hammered out.

j. Cleaning. Clean all components of the mount as directed in paragraph 25.

k. Worms. Remove all nicks or burs (par. 24*c*) and rust or corrosion (par. 24*d*). If the worm thread has worn to a knife edge, replace the worm.

220. Assembly of the Spindle

(fig. 77)

a. Apply a thin film of protective lubricant (par. 26) to the hole in the upper end of the spindle and the end of the spindle extension. Press the spindle extension into the spindle, alining the holes for the taper pin (par. 28). Properly support the spindle and press or drive in the No. 6 x 2½ taper pin (par. 29). If the taper pin hole has been damaged, recondition the hole as directed in paragraph 31.

b. Apply a thin film of protective lubricant (par. 26) to the small hole of the spindle arm and the other end of the spindle extension.

Press the spindle arm on the extension, alining the taper pin holes (par. 28). The spindle arm must form a right angle, to the right, with the spindle. Properly support the spindle arm and press or drive in the No. 6 x 1¾ taper pin (par. 29). If the taper pin holes have been damaged, recondition as directed in paragraph 31.

221. Assembly of the Telescope Holder

For assembly of the telescope holder assembly, which is identical to the telescope holder assembly on the telescope mount M28 (fig. 35), see paragraph 82.

222. Assembly of the Holder

(fig. 76)

a. Lubricate (par. 26) the internal surfaces of the housing and the elevation adjustment worm gear; carefully slide the gear into the telescope holder housing. Screw the 1¼ x 3/16 round nut on the small protruding end of the worm gear. Using a spanner wrench, tighten the round nut until the setscrew holes aline. Screw in the No. 8 (0.164) x 5/32 headless setscrew, to secure the round nut. Using finger pressure, rotate the worm gear. The movement should be smooth and even, without binding or endplay. If any endplay or binding is present, the round nut must be adjusted to remove it. Remove the headless setscrew. Rotate the worm gear and tighten or loosen the round nut until the correct movement is obtained. It is probable that, after adjustment of the round nut, the holes for the setscrew do not aline. It will then be necessary to drill and tap a new hole. This is also true, if a new round nut is used. Using a No. 29 drill, drill a hole 180° from the original hole, half in the round nut and half in the worm gear. Lap the hole with a No. 8–36NF–3 tap. Insert the setscrew and tighten securely.

b. Insert the ½ x 2¼ hex-head cap screw in the telescope holder housing on the same side where the worm gear was inserted. Slide the ½-inch medium lockwasher on the end of the cap screw. Screw the ½-inch regular hex nut on the cap screw and tighten securely.

c. Lubricate (par. 26) the 2⅛-inch long worm and screw the worm into the housing, engaging the worm threads with the hobbed surface of the worm gear. Press the ⅞-inch OD brass collar on the protruding end of the worm. Aline the straight pin holes in the collar and worm. Press or drive in the 3/32 x ⅞ straight pin, to secure the collar to the worm. Loosen the cap screw and, using a screwdriver, rotate the worm. The movement must be without binding. It may be necessary to lap the worm to the worm gear for proper mesh (par. 40).

d. Lubricate (par. 26) the hobbed surfaces of the telescope holder assembly and the bore of the telescope holder housing. Slide the telescope holder assembly carefully into the housing. Screw the 1 x 7/16 brass plug into the threaded end of the telescope holder assembly.

Using a spanner wrench, tighten the plug until the setscrew hole is alined with the drill-point on the telescope holder. Screw the No. 8 (0.164) x 5/32 headless setscrew into the plug and tighten against the holder. Rotate the telescope holder assembly, to test its movement. There must not be any endplay or binding. Remove any endplay or binding by adjusting the plug. Remove the headless setscrew that locks the plug. While rotating the telescope holder assembly, tighten or loosen the plug until the correct movement of the telescope holder is obtained. If the setscrew hole in the plug and the drill-point in the holder do not aline, a new hole must be drilled. If a new plug is used, it will be necessary to drill a hole for the setscrew. On a used plug, drill the hole 180° from the original hole. Use a No. 29 drill and drill deep enough to drill-point the holder. Lap the hole with a No. 8–36NF–3 tap. Insert and tighten the No. 8 x 5/32 headless setscrew.

e. Insert the 1/2 x 2 1/4 hex-head cap screw in the telescope holder housing. Slide a 1/2-inch medium lockwasher on the end of the cap screw. Screw a 1/2-inch regular hex nut on the cap screw and tighten securely. Lubricate (par. 26) the 2 1/8-inch long worm and, using a screwdriver, screw the worm into the housing, engaging the worm thread with the hobbed surface of the holder. Press the 7/8-inch OD brass collar on the protruding end of the worm. Aline the straight pin holes in the worm and press or drive in the 3/32 x 7/8 straight pin, to secure the collar to the worm. Loosen the hex-head cap screw (clamping). Using a screwdriver, rotate the worm. There must not be any binding (par. 44). It may be necessary to lap the worm to the holder (par. 40), to obtain the proper movement.

223. Installation of the Spindle Assembly
(fig. 75)

a. Lubricate (par. 26) the internal surfaces of the mounting bracket and the hobbed surfaces of the spindle. Carefully slide the spindle assembly into the mounting bracket. Screw the 1 3/16 x 7/16 round nut on the lower end of the spindle. Screw the No. 8 (0.164) x 1/4 headless setscrew in the round nut. Do not tighten the setscrew at this time. Tighten or loosen the round nut on the spindle, to remove binding or endplay. When the movement of the spindle is satisfactory, securely tighten the headless setscrew, to lock the round nut.

b. Insert the two 1/2 x 2 1/4 hex-head cap screws that clamp the spindle assembly in the mounting bracket. Slide a 1/2-inch medium lockwasher on each of the two cap screws. Screw a 1/2-inch regular hex nut on each screw and tighten the cap screw and hex nuts.

c. Lubricate (par. 26) the 2 1/8-inch long worm and, using a screwdriver, screw the worm into the mounting bracket. The worm thread must make proper mesh with the hobbed surface of the spindle. Press the 7/8-inch OD brass collar on the protruding end of the worm.

Aline the straight pin holes in the collar and worm. Press or drive in the $^{3}/_{32}$ x $^{7}/_{8}$ straight pin that secures the collar to the worm. Loosen the two hex-head cap screws that clamp the spindle assembly. With a screwdriver, rotate the worm, thereby rotating the spindle. The movement must be without binding or end play. It must be necessary to lap the worm to the spindle (par. 40), to assure perfect rotation of the moving parts.

224. Installation of the Holder Assembly
(fig. 74)

Apply a film of lubricant (par. 26) to the threaded portion of the spindle arm and the threaded portion of the elevation adjustment worm gear. Screw the holder assembly into the spindle arm by means of the worm gear. Tighten the holder assembly in the spindle arm until the taper pin holes aline. Press or drive in the No. 6 x 2 taper pin (pars. 28 and 29). Stake both ends of the taper pin.

225. Installation of the Nameplate
(fig. 73)

Position a serviceable nameplate on the lower end of the mounting bracket. Insert a $^{3}/_{32}$ x $^{1}/_{2}$ button-head rivet in each end of the nameplate and into the mounting bracket. Rivet and buck the rivets securely in place. After riveting, the nameplate must not be loose on the bracket.

226. Installation of the Instrument Light Clamp Assembly
(fig. 73)

Insert the instrument light clamp assembly over the spindle extension. Slide a No. 10 (0.190) medium lockwasher on each of the two No. 10 (0.190) x $^{5}/_{8}$ fillister-head screws. Screw the two fillister-head screws into the lower section of the clamp assembly. Tighten the screws securely.

227. Tests and Adjustments

a. The telescope mount M54 is adjusted when the telescope M26A1 is mounted, and the telescope and telescope mount are boresighted to the axis of the bore of the gun. That is, the reticle range lines of telescope M26A1 are horizontal and the line of sight through the center of the 0-range line is parallel to the axis of the bore of the gun.

b. Adjustment of the round nuts will be found as indicated in (1) through (3) below.

(1) Adjustment of the round nut on the elevation adjustment worm gear (par. 222*a*).

(2) Adjustment of the plug in the telescope holder assembly (par. 222*d*).

(3) Adjustment of the round nut on the spindle assembly (223*a*).

c. Test the movement of the worms by loosening the hex-head cap

screw (clamping). With a screwdriver, rotate the worms a few turns. The movement should be smooth and even, without binding, clicking, backlash, etc. (See paragraphs 34 through 44 for the more common malfunctions of worm gear mechanisms and for tests and remedies.)

228. Installation to the On-Carriage Position

Slide a ½-inch medium lockwasher on each of the four ½ x 1¾ hex-head cap screws. Position the mount on the right side of the gun cradle, back of the indicator-regulator. Insert the cap screws in the mounting bracket and screw into the gun cradle. Tighten the four cap screws securely.

Section XI. TELESCOPE MOUNT M71

229. General

This section contains the procedure for removal, disassembly, rebuild, assembly, tests and adjustments, and installation of the telescope mount M71 (fig. 12).

230. Removal From the On-Carriage Position

Remove the three hex-head cap screws that secure the telescope mount to the on-carriage position. Pry the telescope mount from the weapon.

Note. Use care so as not to damage the hub or straight pins in the mounting bracket.

231. Removal of the Instrument Light Clamp Assembly (fig. 78)

Remove the four round-head screws and lockwashers that secure the instrument light clamp assembly to the mounting bracket. Lift the clamp assembly from the bracket. Remove the lockwashers from the four screws.

232. Removal of the Nameplate (fig. 78)

Remove the two round-head screws that secure the nameplate to the side of the mounting bracket. Remove the nameplate from the bracket.

233. Removal of the Telescope Holder and Telescope Holder Housing Group (fig. 78)

a. Support the collar on the worm and press or drive out the straight pin that secures the collar to the worm. Pull the collar from the worm. Using a screwdriver, unscrew the worm from the mounting bracket.

b. Remove the headless setscrew that locks the round nut to the upper end of the spindle. Using a spanner wrench, unscrew the round nut from the spindle.

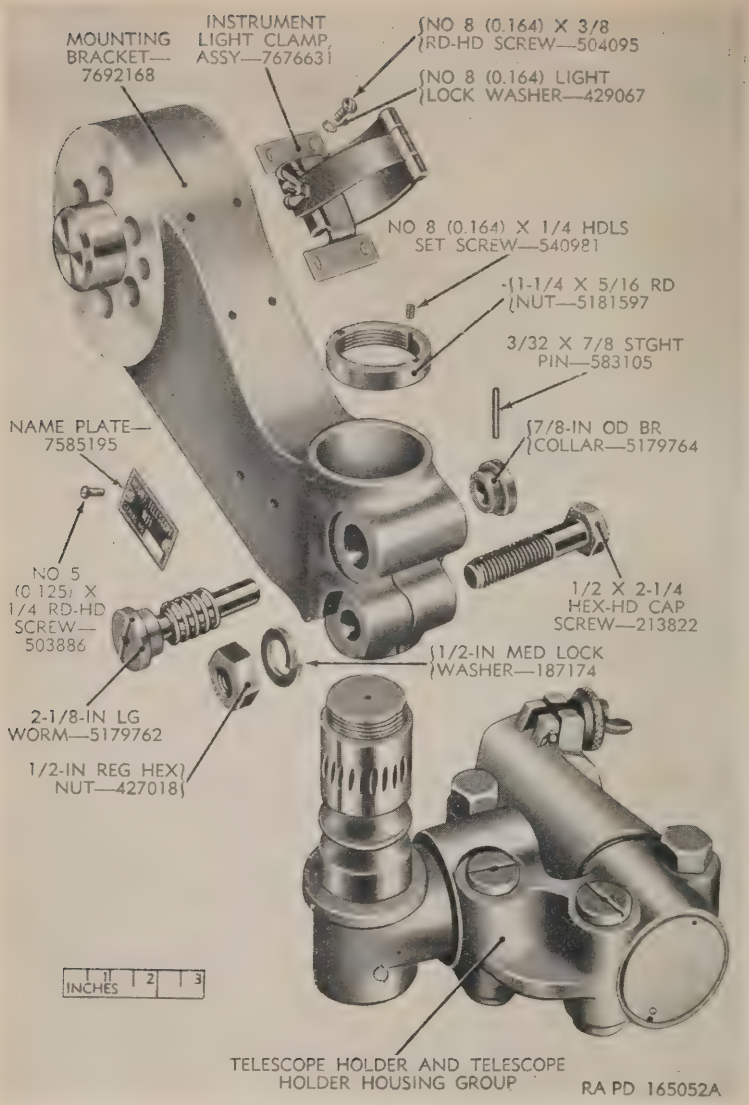

Figure 78. Telescope mount M71—removal of the major assemblies and related parts.

c. Remove the hex nut on the end of the hex-head cap screw. Slide the lockwasher from the cap screw and extract the cap screw from the mounting bracket. Carefully slide the telescope holder and telescope holder housing group from the mounting bracket.

234. Removal of the Telescope Holder Assembly From the Telescope Holder Housing

(fig. 79)

a. Support the collar on the end of the worm. Press or drive out the straight pin that secures the collar to the worm. Pull the collar from the worm. Using a screwdriver, unscrew the worm from the telescope holder housing.

b. Remove the headless setscrew that locks the plug in the telescope holder. With a spanner wrench, unscrew the plug from the telescope holder.

c. Remove the hex nut on the end of the hex-head cap screw (clamping). Slide the lockwasher from the cap screw. Extract the cap screw from the housing. Carefully slide the telescope holder assembly from the telescope holder housing.

235. Removal of the Spindle From the Telescope Holder Housing

(fig. 80)

a. Support the collar on the end of the worm. Press or drive out the straight pin that secures the collar to the worm. Pull the collar from the worm.

b. Remove the headless setscrew that locks the round nut on the spindle. Using a spanner wrench, unscrew the round nut from the end of the spindle.

c. Remove the hex nut on the end of the hex-head cap screw (clamping). Slide the lockwasher from the cap screw. Extract the cap screw from the housing. Carefully slide the spindle from the telescope holder housing.

236. Disassembly of the Instrument Light Clamp Assembly

For disassembly of the instrument light clamp assembly, which is identical to the instrument light clamp assembly on the telescope mount M31 (fig. 39), see paragraph 98.

237. Disassembly of the Telescope Holder Assembly

For disassembly of the telescope holder assembly, which is identical to the telescope holder assembly on the telescope mount M28 (fig. 35), see paragraph 72.

238. Rebuild

a. General. All component parts having seating, locating, or bearing surfaces must be free of nicks, burs, or other deformities. On all threaded components, the threads must not be crossed or damaged. It is very important that the in-process inspection be of the highest standards, since final acceptance of the assembled materiel depends largely upon the care exercised during the in-process inspection.

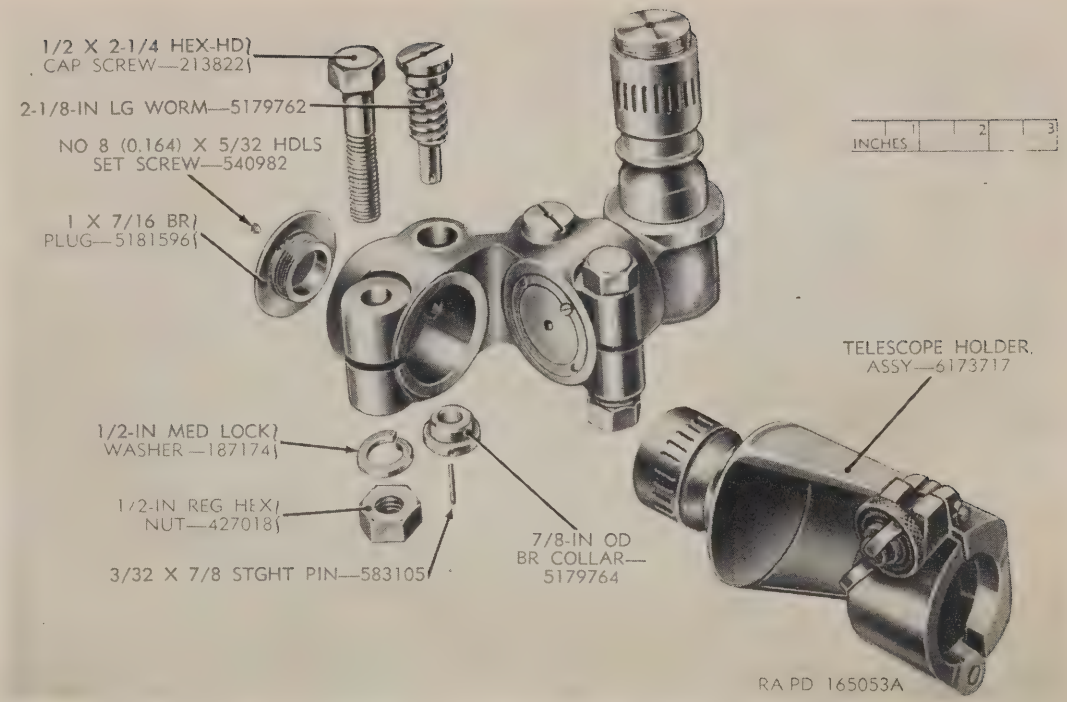

Figure 79. Telescope mount M71– removal of the telescope holder assembly from the telescope holder housing—exploded view.

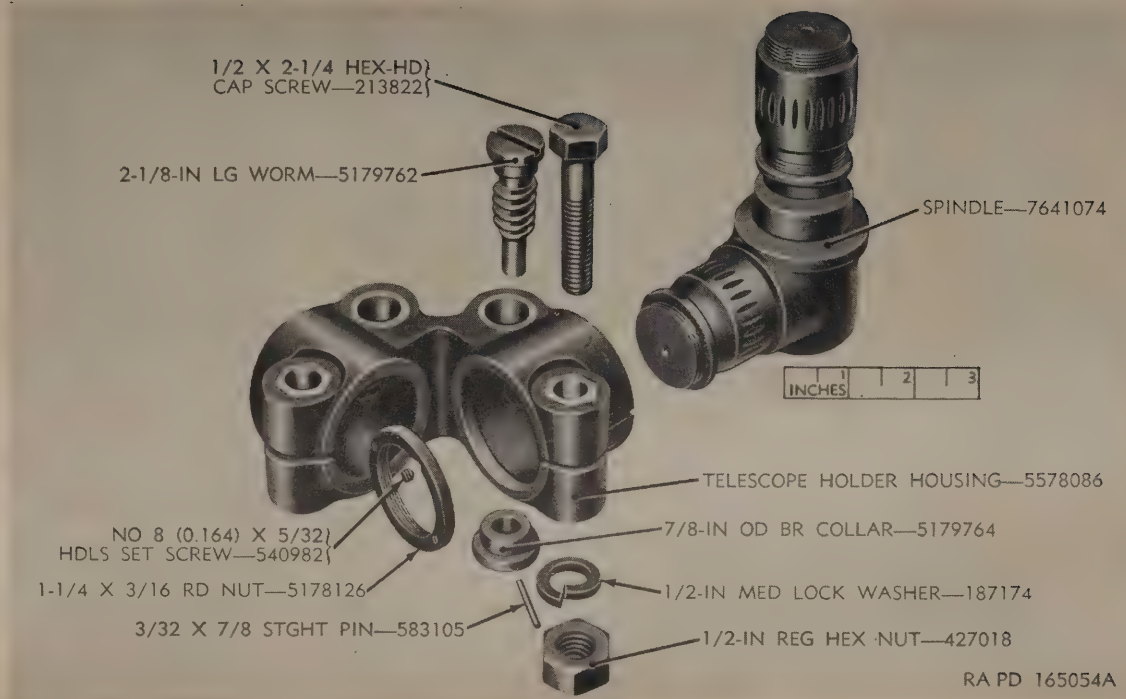

Figure 80. Telescope mount M71—removal of the spindle from the telescope holder housing.

b. Oil Fittings. The oilcups on the housing and the one on the mounting bracket will be pressed out and permanently plugged (par. 26*c*).

Note. Be sure after plugging that the plug does not protrude inside the housing.

c. Worms. Remove all nicks, burs (par. 24*c*), rust, or corrosion (par. 24*d*). Straighten any bent worm as directed in paragraph 35.

Note. If any worm thread has worn to a knife edge, it must be replaced.

d. Spindle. Clean the hobbed surfaces of the spindle. Remove all nicks, burs (par. 24*c*), rust, or corrosion (par. 24*d*).

e. Housing. The internal machined surfaces must be smooth and even. Remove all nicks, burs (par. 24*c*), rust, or corrosion (par. 24*d*).

f. Telescope Holder. See paragraph 77*h*.

g. Instrument Light Clamp Assembly. Remove all nicks or bends by hammering, with care.

h. Threaded Components. Chase all threads with the proper size thread chaser. If chasing is to no avail, replace the component.

i. Cleaning. Clean all components of the telescope mount while it is disassembled (par. 25).

239. Assembly of the Instrument Light Clamp

For assembly of the instrument light clamp assembly, which is identical to the instrument light clamp assembly on the telescope mount M31 (fig. 39), see paragraph 100.

240. Assembly of the Telescope Holder

For assembly of the telescope holder assembly, which is identical to the telescope holder assembly on the telescope mount M28 (fig. 35), see paragraph 82.

241. Installation of the Spindle Into the Telescope Holder Housing

(fig. 80)

a. Lubricate (par. 26) the hobbed surface on the small end of the spindle. Carefully slide the small end of the spindle into the telescope holder housing.

b. Screw the $1\frac{1}{4}$ x $\frac{3}{16}$ round nut on the end of the spindle in the housing. Tighten the round nut with a spanner wrench. Rotate the spindle; the movement must be without binding or end play. Adjust the round nut, to remove binding or end play. While rotating the spindle, tighten or loosen the round nut until the correct movement is obtained. If the setscrew holes are not alined after adjusting the round nut, a new hole must be drilled. Using a No. 29 drill, drill a hole half in the round nut and half in the spindle. Drill the hole 180° from the old hole. Tap the hole with a No. 8–36NF–3 tap. Screw the

No. 8 (0.164) x 5/32 headless setscrew in the hole. Tighten the setscrew securely, to lock the round nut.

c. Insert a 1/2 x 2 1/4 hex-head cap screw (fig. 80) into the telescope holder housing. Slide a 1/2-inch medium lockwasher on the cap screw. Screw a 1/2-inch regular hex nut on the cap screw. Tighten the cap screw and hex nut. This clamps the spindle securely in the telescope holder housing.

d. Lubricate (par. 26) the 2 1/8-inch long worm. Using a screwdriver, screw the worm into the telescope holder housing, adjacent to the clamping screw. Press the 7/8-inch OD brass collar on the protruding end of the worm. Aline the straight pin holes in the worm and collar. Press or drive in the 3/32 x 7/8 straight pin, to secure the collar to the worm.

242. Installation of the Telescope Holder Assembly Into the Telescope Holder Housing

(fig. 79)

a. Lubricate (par. 26) the hobbed surface of the telescope holder. Carefully slide the telescope holder assembly into the telescope holder housing. Screw the 1 x 7/16 brass plug into the end of the holder in the housing. Tighten the plug with a spanner wrench. Rotate the telescope holder. The movement must be smooth, without binding or end play. Adjust the plug, to remove any binding or end play. While rotating the telescope holder, tighten or loosen the plug until the correct movement is obtained. Drill-point the holder directly under the setscrew hole in the plug, using a No. 29 drill. Screw the No. 8 (0.164) x 5/32 headless setscrew into the plug and tighten securely against the telescope holder.

b. Insert a 1/2 x 2 1/4 hex-head cap screw into the telescope holder housing. Slide a 1/2-inch medium lockwasher on the cap screw. Screw a 1/2-inch regular hex nut on the cap screw. Tighten the cap screw and hex nut, thereby clamping the telescope holder assembly in the housing.

c. Lubricate (par. 26) the 2 1/8-inch long worm (fig. 79). Using a screwdriver, screw the worm into the telescope holder housing. Press the 7/8-inch OD brass collar on the protruding end of the worm. Aline the straight pin holes in the collar and worm. Press or drive in the 3/32 x 7/8 straight pin, to secure the collar to the worm.

243. Installation of the Telescope Holder and Telescope Holder Housing Group

(fig. 78)

a. Lubricate (par. 26) the hobbed and bearing surfaces of the spindle. Carefully slide the spindle up into the mounting bracket.

Screw the 1¼ x 5/16 round nut on the end of the spindle. Tighten the round nut against the spindle shoulder. Rotate the spindle. There must not be binding or endplay in the movement. Adjust the round nut, to remove binding or endplay. While rotating the spindle, tighten or loosen the round nut with a spanner wrench. When all binding or endplay has been removed, the round nut is adjusted. If the setscrew holes in the round nut and spindle are not alined, a new hole must be drilled. Using a No. 29 drill, drill a hole 180° from the original hole in the round nut. Drill the hole half in the round nut and half in the spindle. Lap the hole with a No. 8–36NF–3 tap. Screw the No. 8(0.164) x ¼ headless setscrew in the round nut and spindle. Tighten the setscrew securely.

b. Insert the ½ x 2¼ hex-head cap screw in the lower hole on the mounting bracket. Slide a ½-inch medium lockwasher on the cap screw. Screw a ½-inch regular hex nut on the end of the cap screw. Tighten the cap screw and hex nut, thereby clamping the spindle.

c. Lubricate (par. 26) the 2⅛-inch long worm. Using a screwdriver, screw the worm into the mounting bracket. Press the ⅞-inch OD brass collar on the protruding end of the worm. Aline the straight pin holes in the collar and worm. Press or drive in the 3/32 x ⅞ straight pin, to secure the collar to the worm.

244. Installation of the Instrument Light Clamp Assembly

(fig. 78)

Position the instrument light clamp assembly on the top of the mounting bracket, and secure in position with four No. 8(0.164) x ⅜ round-head screws and four light lockwashers.

245. Installation of the Nameplate

(fig. 78)

Position a serviceable nameplate on the side of the mounting bracket and secure in place with two No. 5(0.125) x ¼ round-head screws.

246. Tests and Adjustments

a. General. The main tests and adjustments of the telescope mount M71 are performed when the mount is mounted "on-carriage" and boresighted to the weapon.

b. Adjustment of the Round Nuts. Adjustment of the round nuts on this telescope mount will be found as indicated in (1) and (2) below.

(1) Adjustment of the spindle round nuts (pars. 241*b* and 243*a*).

(2) Adjustment of the telescope holder plug (par. 242*a*).

c. Test of Worm Movement. Loosen the clamping screws adjacent to the worms. Using a screwdriver, rotate the worms a few turns.

There must not be binding, clicking, backlash, or endplay in their movement. It may be necessary to lap (par. 40) the worms to their respective driven members, to remove any binding (pars. 34 through 44).

Note. After assembly and tests and adjustments have been accomplished, plug all screw holes. Use the proper sealing and plugging cement (ORD 3 SNL K–1).

247. Installation to the On-Carriage Position

Press the mount on the weapon, by alining the two $\frac{3}{8}$ x $3\frac{1}{4}$ straight pins in the bracket with the pin holes on the weapon. Insert the three $\frac{1}{2}$ x $3\frac{1}{2}$ hex-head cap screws, with three $\frac{1}{2}$-inch internal-teeth lockwashers, through the mounting bracket and screw securely into the weapon.

CHAPTER 5
FINAL INSPECTION

248. General

Final inspection is performed after repair and rebuild have been completed, to insure that the materiel is serviceable according to established serviceability standards. Check all mounts for completeness and general appearance. The painted surfaces will not have bare spots, scratches deep enough to expose bare metal, or chipped or loose paint. There will be no signs of corrosion. Painting or other finishes will present the appearance of a new instrument.

249. Inspection of Telescope Mounts

Perform all inspections as given in paragraph 17 and tests and adjustments as in *a* through *i* below:

a. Telescope mount M23 (par. 63).
b. Telescope mount M28 (par. 88).
c. Telescope mount M31 (par. 107).
d. Telescope mount M32 (par. 126).
e. Telescope mount M42 (par. 147).
f. Telescope mount M46 (par. 168).
g. Telescope mounts M52C and M52D (par. 206).
h. Telescope mount M54 (par. 227).
i. Telescope mount M71 (par. 246).

250. Inspection for Telescope Mounts M23, M28, M31, M42, M46, M54, and M71

a. Each mount will hold its respective elbow telescope firmly, without perceptible strain.

b. When the locking screws adjacent to the adjusting screws on the telescope mount M42 are tight, they will lock the mount firmly in position.

c. When the clamping screws adjacent to the adjusting worms on the other mounts are tight, they will lock the worms.

d. With the clamping screws loose, the adjusting screws on the mount M42 and the adjusting worms on the other mounts will turn freely throughout their entire range of movement.

e. Turn the worm knob slowly on telescope mounts M23, M28, and M31; the movement will be smooth and even.

f. The threads on the adapter of the telescope mounts M23 and M42 will be free from nicks or burs; the threads will not be crossed or damaged.

g. The instrument light clamp assemblies will not be bent or twisted. The clamping nuts will work freely and the hinges will open and close freely without binding.

h. With the telescope mounts set up on a suitable testing fixture, using a properly alined target and elbow telescope mounted in place, the line of sight will follow a plumb line target within a tolerance of 2.8 mils when the telescope is elevated 300 mils.

i. With the telescope mount M23 set up on a suitable testing fixture, using a properly alined target and with the elbow telescope M16 correctly clamped in the mount, the line of sight of the telescope will be perpendicular in a horizontal plane to the center line of the mount support within 2.0 mils.

251. Inspections for Telescope Mount M32

a. The gear train will be free of nicks or burs and will turn smoothly. There will be no appreciable backlash in this gear train (par. 126).

b. Loosen the lock screws for the three boresighting adjustments. The worms will turn smoothly, when turned with a screwdriver. Tightening the clamping screws and nuts with a wrench will lock the worm movements, so that they cannot be turned with the aid of a screwdriver.

252. Telescope Mounts M52C and M52D

a. Adjustment. Clamp the mount on a vertical surface, so the mount is held in the position shown in figures 12 and 13. Mount an elbow telescope M6A1 in position. With the index on "10" (0 deflection) and the micrometer on "0," the line of sight of the telescope will form a 60° angle with the mounting surface. Set up a target, so the mount can be checked up to 7° either side of "10" (0 deflection).

b. Azimuth Movement. There will be at least 7° movement on either side of the "10" (0 deflection) graduation.

c. Elevation Movement. The elevation mechanism will move freely throughout its entire range, without undue looseness or friction.

d. Azimuth Index. The azimuth index will coincide with one of the graduations on the azimuth scale, when the micrometer is setting on the "0" graduation.

e. Accuracy. Error in any azimuth reading will not exceed $\pm 0.02°$. Each mount will be checked for accuracy of azimuth readings at not less than five different settings.

f. Backlash.

(1) Backlash between the elevation worm and segment will not exceed ±0.088-inch movement on the periphery of the elevation knob.

(2) Backlash between the azimuth worm and segment will not exceed ±0.01 degree.

g. Detent Action (on the Azimuth Worm). The spring will be of sufficient strength to snap into the detent of each of the 100 positions, but the worm will turn when medium pressure is applied to the azimuth knob.

h. Lubrication. The mounts will be lubricated with the proper aircraft and instruments grease (ORD 3 SNL K–1) at the time of rebuild.

i. Lighting Equipment.

(1) The insulation on the cable assemblies will be free from mold, breaks, abrasions, and exposed wires.

(2) The plugs on the cable assemblies will fit and lock properly in their respective sockets. The plugs will not be corroded, deformed, or loose on the cable.

(3) When connected to a 6-volt power source, the switch must function properly and the lamp must light when the switch is in the ON position.

APPENDIX

REFERENCES

1. Publication Indexes

Special Regulations in the 310–20 series, SR 110–1–1, ORD 1, FM 21–8, and SB 9–1 should be consulted frequently for latest changes or revisions of references given in this appendix and for new publications relating to materiel covered in this manual.

2. Supply Manuals

The following manuals of the Department of the Army supply manual pertain to this materiel:

a. Destruction to Prevent Enemy Use.

Land Mines and Components; Demolition Explosives and Related Items; and Ammunition for Simulated Artillery, Booby Trap, Hand Grenade, and Land Mine Fire---------- ORD 3 SNL R–7

b. Repair and Rebuild.

Cleaners, Preservatives, Lubricants, Recoil Fluids, Special Oils, and Related Maintenance Materials---------- ORD 3 SNL K–1
Items of Soldering, Metalizing, Brazing, and Welding Materials; Gases and Related Items---------- ORD 3 SNL K–2
Lubricating Equipment, Accessories, and Related Dispensers---------- ORD (*) SNL K–3
Lubricating Fittings, Oil Filters, and Oil Filter Elements---------- ORD 5 SNL H–16
Major Items and Major Combinations of Group F------ ORD 3 SNL F–1
Miscellaneous Hardware---------- ORD 5 SNL H–2
Standard Hardware---------- ORD 5 SNL H–1
Tool Set, Fire Control Repairman---------- ORD 6 SNL J–10, Section 13
Tool Set, Instrument Repairman (MOS 3922)-- ORD 6 SNL J–10, Section 14
Tool Sets for Maintenance of Sighting and Fire Control Equipment---------- ORD 6 SNL F–272

c. Sighting and Fire Control Equipment.

Mount, Telescope, M21A1, M23, M31, and M76- ORD (*) SNL F–197, Section 2
Mount, Telescope, M28, M46, M52C, M52D, M54, and M71; Telescope Elbow, M24A1 and M26A1---------- ORD (*) SNL F–224
Mount, Telescope, M31 and M32---------- ORD (*) SNL F–375
Mount, Telescope, M42---------- ORD (*) SNL F–256
Mount, Telescope, M71---------- ORD (*) SNL F–376

(*) See SR 310–20–29 for published manuals of the ordnance section of the Department of the Army supply manual.

3. Forms

The following forms pertain to this materiel:

DA Form 9–71, Locator and Inventory Control Card
DA Form 9–72, Ordnance Stock Record Card
DA Form 9–76, Request for Work Order
DA Form 9–77, Job Order Register
DA Form 9–78, Job Order
DA Form 9–79, Parts Requisition
DA Form 9–80, Job Order File
DA Form 9–81, Exchange Part or Unit Identification Tag
DA Form 446, Issue Slip
DA Form 447, Turn-in Slip
DA Form 468, Unsatisfactory Equipment Report
DA Form 811, Work Request and Job Order
DA Form 811–1, Work Request and Hand Receipt
DA Form 828, Job Time Ticket—Individual
DA Form 829, Rejection Memorandum
DA Form 865, Work Order
DA Form 866, Consolidation of Parts
DA Form 867, Status of Modification Work Order
DD Form 6, Report of Damaged or Improper Shipment

4. Other Publications

The following publications contain information pertinent to this materiel and associated equipment:

a. Camouflage.

Camouflage, Basic Principles ..... FM 5–20

b. Decontamination.

Decontamination ..... TM 3–220
Defense Against Chemical Attack ..... FM 21–40

c. Destruction to Prevent Enemy Use.

Explosives and Demolition ..... FM 5–25
Ordnance Service in the Field ..... FM 9–5

d. General.

Inspection of Ordnance Materiel in the Hands of Troops ..... TM 9–1100
Accident Reporting ..... SR 385–10–40
Artillery Materiel and Associated Equipment ..... TM 9–2300
Unsatisfactory Equipment Report ..... SR 700–45–5

e. Repair and Rebuild.

Abrasive, Cleaning, Preserving, Sealing, Adhesive, and Related Materials Issued for Ordnance Materiel ..... TM 9–850
Electrical Testing Apparatus for Fire Control Equipment ..... TM 9–1672
Fire Control Materiel: Lubrication ..... TB 9–2835–1
Hand, Measuring, and Power Tools ..... TM 10–590
Instruction Guide: Care and Maintenance of Ball and Roller Bearings ..... TM 37–265
Instruction Guide: Elementary Optics and Applications to Fire Control Instruments ..... TM 9–2601
Instruction Guide: Instrument Repairman ..... TM 9–2602
Instruction Guide: Welding Theory and Application ..... TM 9–2852

Lubrication ..... TM 9–2835
Maintenance and Care of Hand Tools ..... TM 9–867
Maintenance of Supplies and Equipment: Maintenance Responsibilities and Shop Operation ..... AR 750–5
Modification of Ordnance Materiel ..... SB 9–38
Operation and Maintenance of Optical Coating Equipment ..... TM 9–1501
Ordnance Maintenance and General Supply in the Field ..... FM 9–10
Painting Instructions for Field Use ..... TM 9–2851
Shop Mathematics ..... TM 9–2820

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[AG 413.74 (17 Dec 53)]

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NG: Same as Active Army except one copy to each unit.

USAR: None.

For explanation of distribution formula, see SR 310–90–1.

U. S. GOVERNMENT PRINTING OFFICE: 1954

PIONEER ENGINEERING WORKS

Part No. CP-23982

JAN 23 1956

JUN 14 1956

TM9-6101-3